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## THE ASSESSMENT AND UTILIZATION OF PATIENTS' SELF-EFFICACY FOR EXERCISE DURING REHABILITATION

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THE ASSESSMENT AND UTILIZATION OF PATIENTS' SELF-EFFICACY FOR  
EXERCISE DURING REHABILITATION

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DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Health Sciences  
at the University of Kentucky

By

Kelsey J. Picha

Lexington, Kentucky

Co-Directors: Dr. Tim L. Uhl, Professor of Athletic Training and Rehabilitation Sciences  
and Dr. Gilson Capilouto, Professor and Director of Undergraduate Research

Lexington, Kentucky

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## ABSTRACT OF DISSERTATION

### THE ASSESSMENT AND UTILIZATION OF PATIENTS' SELF-EFFICACY FOR EXERCISE DURING REHABILITATION

Patient adherence to in-clinic rehabilitation is between 30-70% and even lower for home exercise programs (HEPs). Barriers to patient adherence have been identified and include but are not limited to anxiety, depression, lack of positive feedback, lack of social support, lack of time, low levels of physical activity at baseline, pain during exercise, and low self-efficacy. As clinicians prescribing rehabilitation may not be able to influence all of the identified barriers, they may positively influence others. Self-efficacy, or an individual's belief in his/her ability to successfully complete a task, is a patient barrier that may be addressed by a clinician when aware of low self-efficacy and have tools to improve this barrier. Interventions to overcome this specific barrier have demonstrated an increase in not only self-efficacy but patient adherence as well. Although interventions have proven to be successful, patient adherence has yet to increase according to the literature. At this time, there is no evidence to suggest that clinicians are assessing an individual's level of self-efficacy prior to prescribing HEPs. In addition, there is no known metric to measure self-efficacy for HEPs in patients rehabilitating musculoskeletal conditions. Assessment of patient barriers, specifically self-efficacy, needs to be a standard of care in order to increase adherence, in turn, improve patient outcomes and to reduce the cost to our healthcare system.

The first purpose of this dissertation was to determine in patients with musculoskeletal conditions what scales have been developed and evaluated for assessing self-efficacy in conjunction with adherence. In addition, to determine if a tool exists specifically to assess self-efficacy for HEPs. Due to the task and situation-specific nature of self-efficacy, it is important that this construct is reflected in the assessments utilized by clinicians. The second purpose was to determine the importance and utilization of patients' self-efficacy to physical therapists when addressing patient barriers. This included determining how physical therapists assess patient self-efficacy and barriers to assessment. The third purpose was to develop the Self-Efficacy for Home Exercise Programs Scale and determine the psychometric properties of the instrument. This also allowed for the examination of how self-efficacy relates to patient adherence in a musculoskeletal patient population.

The results of the first study suggest that within the musculoskeletal literature, a number of scales are being used to assess patient self-efficacy. These scales are either task, situation, or condition specific. No scale was found to assess self-efficacy for HEPs. This finding indicates the need to develop a scale to assess self-efficacy for HEPs. In the second study, 71% (n = 329/464) of physical therapists, disclosed assessing self-efficacy prior to prescribing HEPs and rated self-efficacy as very to extremely important when it comes to their patients' adherence. Verbal discussion is the most common method of self-efficacy assessment (50%), followed by

observation of the patient (38%), then patient self-report questionnaires (10%). Commonly, physical therapists report using verbal discussion and observation in combination. Of the 29% of the physical therapists that do not assess self-efficacy, 40% report not knowing how to assess self-efficacy, 19% are not sure what to do with the information once self-efficacy is assessed, 16% claim there are other barriers to assessment, 15% claim that assessing self-efficacy will not change their practice, another 9% claim assessing self-efficacy takes too much time, and the last 1% do not know what self-efficacy is. These results further suggest the need for a scale to assess self-efficacy for HEPs. The purpose of the final study was to develop a Self-Efficacy for Home Exercise Programs Scale. The scale was found to have high internal consistency ( $\alpha = 0.96$ ), acceptable test-retest reliability (ICC = 0.8, SEM = 5, MDC = 7), and strong convergent validity with the Self-Efficacy for Exercise scale ( $\rho = 0.83$ ,  $p < 0.01$ ). Unique to this scale, a cutoff score was determined to be 59 points with a positive likelihood ratio of 2.0 (95% CI 1.1 – 2.5) indicating those who score below 59 points on the SEHEPS would be 2 times more likely to be non-adherent than adherent to their HEP. A weak to moderate, positive relationship was detected between the patients' initial level of self-efficacy for their HEP and adherence ( $\rho = 0.38$ ,  $p = 0.03$ ). These results suggest that the Self-Efficacy for Home Exercise Programs Scale may be utilized by rehabilitation clinicians to assess self-efficacy for HEPs. Clinically, this scale may provide clinicians the ability to decipher patients who are not likely to adhere to their prescribed HEP, allowing clinicians to intervene immediately. Early intervention to improve self-efficacy may increase adherence to HEPs and eventually patient outcomes.

KEYWORDS: musculoskeletal, adherence, patient-reported outcomes, psychometric properties

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Student's Signature

June 12<sup>th</sup>, 2018

Date

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## Chapter 1: Introduction

### Background

Musculoskeletal injuries affect a large percentage of the population annually,<sup>3</sup> amounting to billions of dollars in total costs for the United States healthcare system.<sup>4</sup> Rehabilitation of musculoskeletal injuries is an important component of the recovery process and plays a major role in returning the individual to normal function.<sup>5-7</sup> In-clinic rehabilitation is commonly supplemented with home exercises for the patient to regain mobility and strength. Home exercise programs (HEPs) complement the progress achieved in-clinic and reinforce motor learning. Continual practice, through HEPs, allows individuals to develop the skills or exercises further taught in-clinic<sup>8</sup> and aids in improving patient function, long-term outcomes, and reduces recurrent injury.<sup>9</sup> Despite the extensive known benefits of rehabilitation,<sup>5,6,7</sup> patients have been found to be non-adherent all too often. Adherence to in-clinic rehabilitation is low ranging from 30-70% being non-adherent to the treatment prescribed by clinicians.<sup>10,11</sup> Adherence to HEPs has been determined to be even lower, reported as low as 13%.<sup>10,12</sup> The lack of adherence to rehabilitation is an issue for the patient and our healthcare system. As patient-centered care is the goal of well-developed rehabilitation programs, patient-reported outcomes are commonly used to assess a patient's functional progress. Patient adherence has been identified as a precursor to increasing patient-reported outcomes<sup>13, 14</sup> and non-adherence places patients at risk for reduced outcomes,<sup>15</sup> such as limited functional ability.<sup>16</sup> Patients found to be non-adherent to treatment programs experience considerable deterioration of their musculoskeletal condition and increase the risk of complications, costing the healthcare system additional money annually.<sup>17,18</sup> Barriers to rehabilitation exercise adherence need to be identified to increase adherence, improve patient outcomes, and reduce the financial burden.

Research has indicated that barriers, not motivators, are better predictors of a patient's lack of adherence to rehabilitation.<sup>19</sup> Barriers to exercise rehabilitation adherence have been studied exhaustively in various patient populations. Common barriers to rehabilitation exercise adherence have emerged; some of which clinicians may or may not have the ability to change. Barriers that clinicians may not be able to influence due to lack of additional training include anxiety, depression, and helplessness.<sup>10,20</sup> Barriers that clinicians may have the ability to improve through practice include increased pain with exercise, lack of social support, lack of positive feedback, and low self-efficacy.<sup>10,20</sup> A recent systematic review identifies that greater self-efficacy predicts adherence to HEPs in patients with various musculoskeletal conditions.<sup>12</sup> This review suggests the importance of patient self-efficacy is not limited to a specific population.<sup>12</sup> In

patients with chronic low back pain, self-efficacy was found to be an important variable in understanding the relationship between a patient's function and pain when compared to other variables;<sup>21</sup> greater self-efficacy has been associated with less disability and pain.<sup>22</sup> Given this relationship, self-efficacy may simultaneously address a number of other modifiable barriers to improve patient adherence. Before implementing assessment strategies or interventions to improve self-efficacy, it is important to have an understanding of this construct.

Self-efficacy is a construct of Albert Bandura's Social Cognitive Theory. Self-efficacy is an individual's belief that he or she will successfully complete a specific task,<sup>23,24</sup> and plays a profound role in patient behavior and intentions.<sup>24</sup> Individuals with higher self-efficacy for exercise are reported to engage in exercise 1.5 times more often than those with lower self-efficacy.<sup>25</sup> Additionally, Litt et al. studied predictors for exercise participation in women with low bone density and found that self-efficacy was the only predictor of adherence to exercise maintenance over time.<sup>26</sup> The beliefs that determine one's level of self-efficacy have four sources 1) mastery experiences, 2) vicarious experiences, 3) verbal or social persuasion, and 4) physiological or emotional state.<sup>23,24</sup> This model and theory emphasize that cognition is crucial for human functioning and patient action.<sup>27</sup> Research suggests that self-efficacy influences a patient's decision-making abilities, as well as the initiation and maintenance of the prescribed rehabilitation programs.<sup>28</sup> Low self-efficacy is a determinant of rehabilitation exercise adherence,<sup>29</sup> but also a strong predictor of intentions to engage in other health behaviors.<sup>30,31</sup> Those with high self-efficacy beliefs tend to set high goals, accept challenges, and be more resilient when faced with failure or setback.<sup>23</sup> Patients with high self-efficacy may also be more adherent to rehabilitation, while those with low self-efficacy may struggle with adherence as they tend to avoid challenges or demonstrate lack of effort, and may even face additional barriers.<sup>32</sup> Low self-efficacy is one of the few barriers to rehabilitation exercise adherence that clinicians may work to improve.

Past research has indicated that rehabilitation clinicians are able to positively influence patient self-efficacy within their standard of care and in turn also improve patient adherence.<sup>33-35</sup> Because self-efficacy has been identified as a strong predictor of exercise performance in heart failure patients,<sup>36</sup> working to improve self-efficacy through interventions should aid in improving adherence to rehabilitation exercise as well. Cardiac rehabilitation interventions focused on improving self-efficacy for exercise have provided an improvement to both self-efficacy and adherence.<sup>33</sup> The importance of exercise adherence in cardiac patients is similar in those with musculoskeletal conditions, as adherent patients have better outcomes and improve quality of

life.<sup>14,37</sup> Millen et al. developed a theory-based resistance training manual for patients undergoing cardiac rehabilitation with emphasis on self-efficacy.<sup>38</sup> The subjects in the experimental group that used the manual focused on promoting self-efficacy were found to have improved self-efficacy, improved outcome expectations, and increased adherence at a 4-week follow-up compared to a wait-list group not receiving the manual.<sup>38</sup> Specifically, the intervention group (mean number of exercises = 43.9) was almost 50% more adherent with their exercises than the control group (mean number of exercises = 21.4, Cohen's  $d = 1.08$ ,  $p = 0.002$ ).<sup>38</sup> Other interventions such as goal setting, cognitive behavioral therapy, or providing additional feedback and social support have been found to increase patient self-efficacy.<sup>39-43</sup> Although other areas of healthcare have begun to address the issue of low self-efficacy in their patients,<sup>33,44,45</sup> it is unclear if clinicians in musculoskeletal rehabilitation are assessing and utilizing a patient's self-efficacy to individualize care. The assessment of patient's self-efficacy should take place within standard of care prior to the implementation of any intervention.

### **Statement of the Problem**

Billions of dollars are spent on treatment of musculoskeletal injuries,<sup>4</sup> but there appears to be a significant lack of adherence leading to sub-optimal function. Musculoskeletal rehabilitation is critical to return patients to normal function following injury or surgery. Yet, estimates in the hundreds of billions of U.S. dollars are spent due to patients' lack of adherence to prescribed medical regimens.<sup>18,46</sup> In heart failure patients undergoing cardiovascular rehabilitation, self-efficacy has had a moderate impact on improving exercise adherence,<sup>33</sup> but to date, limited information exists on the impact self-efficacy has on improving exercise adherence in musculoskeletal conditions. Low self-efficacy has been observed to be associated with a decrease in function in patients with chronic musculoskeletal pain.<sup>47</sup> The effectiveness of increasing self-efficacy to increase musculoskeletal exercise adherence has not yet been well established. Further, there is not a clear understanding that self-efficacy is even being considered when evaluating a patient before prescribing home exercises for a musculoskeletal injury. Currently, it is unknown if a standard measure of self-efficacy for HEPs has been used to assess self-efficacy in patients with musculoskeletal conditions. Further, to what extent are clinicians evaluating self-efficacy and the barriers to assessment if they are not evaluating. If a tool is not well established, then a task-specific tool needs to be developed to evaluate self-efficacy for HEPs.

## **Statement of the Overall Purpose**

The overarching purpose of this dissertation is to investigate the use of self-efficacy by clinicians in musculoskeletal exercise rehabilitation when individualizing patient treatment to improve adherence to HEPs. The development of a self-efficacy scale specific to HEPs and evaluation of its psychometric properties will be conducted to determine if it relates to HEP adherence.

## **Statement of Overall Significance**

The results of these studies will provide researchers with a better understanding of how patients' self-efficacy for exercise during rehabilitation following a musculoskeletal injury is utilized by clinicians. Specifically, identification of the methods currently being employed to assess patient self-efficacy that are presented in the literature needs to be evaluated. Identifying self-efficacy assessment methods that are currently used will allow researchers to determine if any have been created for HEPs. If this has not been established in musculoskeletal rehabilitation, then the need is apparent to understand why which will be accomplished by a survey of practicing clinicians. This survey will inform researchers on the importance of patients' self-efficacy to the typical clinician and whether assessment is part of their standard of care. If found that self-efficacy is being assessed, determine what methods are used and if not, determine what are the barriers to self-efficacy assessment. Finally, the development of a new tool that is reliable and valid will provide clinicians with a better method to evaluate self-efficacy for HEPs. This eventually may allow clinicians to make modifications or clarify the responsibility of the patient for completion of their home exercise program. This tool can then be used to further evaluate if it can help improve patient outcomes in future research which will lead to better patient outcomes following a musculoskeletal injury.

## **Specific Research Aims and Hypotheses**

This dissertation is divided into three separate studies each with a different focus, but all address how the concept of self-efficacy is used or is considered in musculoskeletal rehabilitation. As self-efficacy is task and situation-specific, the final study focuses on the development of a new self-efficacy for HEPs scale and the evaluation of its psychometric properties.

Study One: Measurements of Self-Efficacy in Musculoskeletal Rehabilitation: a Systematic Review

Specific Aim 1.1: To determine what self-efficacy scales are being used in conjunction with exercise adherence.



Specific Aim 1.2: To identify if any self-efficacy scale has been developed to assess self-efficacy for HEPs specifically.

Specific Aim 1.3: To determine the psychometric properties of each scale identified.

Specific Aim 1.4: To determine which scales are being used to predict adherence to rehabilitation exercise.

This systematic review determines the self-efficacy scales used in musculoskeletal rehabilitation exercise when simultaneously addressed with adherence outcomes within the literature. Although patient barriers to rehabilitation exercise adherence are known, the likelihood that researchers are addressing these barriers in intervention studies is unknown. Additionally, this study determines the methods being utilized to assess self-efficacy for exercise during rehabilitation and which is the most common. CINAHL, Medline, PubMed, PsycINFO, and Sport Discus are the primary databases searched. Specific inclusion and exclusion criteria were established prior to searching key terms. Titles and abstracts were reviewed to determine what full-text articles to include. Two authors reviewed the full-text articles to determine inclusion based on predetermined criteria. This study provides insight into the assessment of self-efficacy within rehabilitation of musculoskeletal disorders and aids in determining the need for improved assessment measures.

Study Two: Physical Therapists' Assessment of Patient Self-Efficacy for Home Exercise Programs

Specific Aim 2.1: To determine the relative importance of patients' self-efficacy to clinicians when addressing patient barriers to rehabilitation exercise adherence.

Specific Aim 2.2: To determine how clinicians are assessing and utilizing patients' self-efficacy for home rehabilitation exercise adherence.

Specific Aim 2.3: To determine the barriers facing clinicians in assessing patients' self-efficacy for home rehabilitation exercise adherence.

Study two determines whether physical therapists are assessing patients' self-efficacy for home rehabilitation exercise. Due to high time demands on physical therapists providing patient care, it is hypothesized that 50% of physical therapists do not assess patient self-efficacy for home rehabilitation exercise. This survey-based study seeks to determine how physical therapists are assessing patient self-efficacy for HEPs. For those physical therapists who respond to not assessing barriers, they were asked for reasoning. Limited time is hypothesized to be the number

one barrier for those who do assess patient self-efficacy for HEPs. Physical therapists were recruited via email and provided a direct link to the survey on Qualtrics. The survey contains approximately 10 questions including binary, multiple choice, and open-ended. The number of questions asked was based on the participant's response to other questions, as some questions that populate others required an explanation. Upon completion of the survey, there were seven demographic questions asked (sex, date of birth, degree, occupation, years of experience, practice setting, and location of practice). This study identified whether or not physical therapists use patient barriers to rehabilitation to individualize care further. With the understanding of how these barriers are being assessed, the researchers can improve assessments or intervention strategies based on the collected information. With insight into why clinicians do not assess patient barriers, the researchers can begin to explore improved implementation strategies based on reasons for lack of use.

### Study Three: The Self-Efficacy for Home Exercise Programs Scale Development and Psychometric Properties

Specific Aim 3.1: To develop and evaluate the psychometric properties of a tool for assessing self-efficacy for HEPs entitled, the Self-Efficacy for Home Exercise Programs Scale (SEHEPS).

Specific Aim 3.2: To examine how self-efficacy relates to adherence to HEPs and the change in self-reported function post-rehabilitation.

The third study seeks to develop a scale to evaluate patients' self-efficacy for their prescribed HEP. This aim has three hypotheses: 1) that the new patient-specific questionnaire on self-efficacy for HEPs will have internal consistency greater than  $\alpha = 0.7$ , 2) the new scale will be positively correlated with the Self-Efficacy for Exercise and Pain Self-Efficacy Questionnaire, and 3) those patients with higher self-efficacy for HEPs have a higher reported adherence rate and greater change in self-reported function than those with low self-efficacy. Internal consistency will be evaluated using Cronbach's  $\alpha$  coefficient for all initial self-efficacy measures to determine which items are inter-correlated. An intra-class correlation coefficient value between 0.70-0.90 will be considered satisfactory.<sup>48</sup> Convergent validity will be evaluated using a Spearman product-moment correlation between the three initial self-efficacy questionnaires. Lastly, patients will be requested to complete an exercise adherence log by checking "yes" or "no" to whether or not they completed their exercises as prescribed throughout the 4-week study. The exercise logs were returned at the final study visit. Adherence was then analyzed with the initial visit self-efficacy for HEPs and reported function. If these hypotheses are supported, then clinicians will

have a scale to identify patients who have low self-efficacy for HEPs. By identifying these patients at the first visit, clinicians can alter and individualize patient care to improve patient adherence.

### **Assumptions**

- Clinicians will answer survey questions truthfully and provide answers that reflect their understanding and use of patient barriers to rehabilitation adherence, especially self-efficacy.
- Patients will understand all patient-reported outcome measures (Self-Efficacy for Home Exercise Programs, Self-Efficacy for Exercise, and the Pain Self-Efficacy Questionnaire) and answer truthfully to the best of their ability.

### **Delimitations**

- The clinicians surveyed will be limited to members of the American Physical Therapy Association, specifically those who choose to respond to the email inquiry.
- Patients included were between the ages of 18-70 years old.
- Rehabilitation programs in-clinic and at home were not controlled.
- Patients may overestimate their adherence to HEPs to please the researcher or clinician.

### **Operational Definitions**

Adherence: Patient voluntary involvement in their plan of care to promote the desired therapeutic effects, or the extent to which the patient agrees to the plan of care determined in collaboration with a clinician.

Convergent validity: A subtype of construct validity, establishes if other scales measuring the same construct are similar and relate highly to one another. In this dissertation, convergent validity will refer to the relationship between the Self-Efficacy for Home Exercise Programs Scale, the Self-Efficacy for Exercise scale, and the Pain Self-Efficacy Questionnaire. A correlation of 0.70 or greater must be obtained to be considered a strong or high correlation.

Exercise log adherence: Reports of 70% or higher completion of home exercises will be considered adherent, those less than 70% will be considered non-adherent.

Home exercise programs (HEPs): Prescribed rehabilitation exercise programs patients are to complete at home in addition to in-clinic rehabilitation.

Internal consistency: Reliability based on one administration of the Self-Efficacy for Home Exercise Programs Scale to determine if items within the scale address the same underlying construct. A Cronbach's alpha of 0.9 will be considered excellent.

Mastery experience: A hypothesized source/antecedent of self-efficacy that includes experiences of an individual may be either one's past successes or failures of a task, behavior, or situation. Also known as performance accomplishments. Key phrases such as "build confidence," "successful completion of exercises," "patient properly demonstrates exercise," "goal setting," and "break down tasks" were placed into this theme in Chapter 4.

Participant: The respondents of the survey-based study.

Physiological or emotional state: A hypothesized source/antecedent of self-efficacy that includes the body's emotional arousal or reaction to tasks and situations. Key phrases such as "patient education related to symptoms/pain" and "reduce pain" were placed into the physiological or emotional state theme.

Self-Efficacy for Home Exercise Programs Scale (SEHEPS): Scale created to identify those with low self-efficacy for completing HEPs. This scale is comprised of 12-items that can be rated on a 7-point Likert scale from "Not confident" to "Confident."

Verbal or social persuasion: A hypothesized source/antecedent of self-efficacy that involves suggestions from others about one's abilities. May involve encouragement or support from others, could be positive or negative. Key phrases such as "discussion with the patient," "provide encouragement or positive feedback," "provide social support," and "use of cueing techniques," were placed within the verbal/social persuasion this theme.

Vicarious experience: A hypothesized source/antecedent of self-efficacy involving an individual's observation of others' successes and/or failures, in other words, performance modeling. Key phrases placed into the vicarious experience category included "I demonstrate exercises," "show patients how to successfully complete an exercise," or "use of models."

## **Chapter 2: Literature Review**

### **Introduction**

Rehabilitation of musculoskeletal injuries is essential for healing and returning to function. Unfortunately, patients are not always adherent to what is prescribed by their rehabilitation clinician. The purpose of this literature review is to 1) discuss the issue of patient adherence and the barriers to exercise adherence in rehabilitation, 2) discuss social cognitive theory with the emphasis on self-efficacy, 3) discuss the relationship between adherence and self-efficacy, and 4) explore the use of self-efficacy in rehabilitation.

### **Prevalence and Cost of Musculoskeletal Injuries**

Musculoskeletal disease and injuries affect a large percentage of the population annually.<sup>3</sup> According to the United States Bone and Joint Initiative, approximately one out of two people ages 18-64 and three out of four people ages 65 and over are affected by musculoskeletal disorders.<sup>4</sup> The high prevalence of musculoskeletal conditions has been estimated to account for 77% of healthcare visits (approximately 65.8 million), costing up to \$176.1 billion in 2011.<sup>4</sup> The cost of the general population's health and cost to our healthcare system is quite substantial. Reduction in cost may come from treatment and rehabilitation following diagnosis. The care provided to the majority of musculoskeletal disease and injuries consists of rehabilitation.

### **The Importance of Rehabilitation**

Rehabilitation is often prescribed as the standard of care following a musculoskeletal injury to promote healing and recovery. The benefits to rehabilitation include reduction of pain,<sup>5</sup> improvements in quality of life, and increase in range of motion, strength, and function.<sup>6,7,49</sup> Standard of care does not only include in-clinic rehabilitation with a clinician but also home exercise programs.<sup>50,51</sup> Home exercise programs (HEPs) are commonly implemented to complement in-clinic rehabilitation. Because patients' cannot be seen every day in the clinic due to insurance regulations, cost, and time constraints, patients' must continue to work to improve their condition on their own at home. Continual practice allows individuals to develop the skills or exercises further taught in-clinic.<sup>8</sup> Home exercise programs not only reinforce motor learning, but aid in improving patient function, long-term outcomes, and reduce recurrent injury.<sup>9</sup> The American College of Sports Medicine recommends that adults, healthy or suffering from disease/disability, perform resistance exercise 2-3 days per week and flexibility exercises two or more days per week to improve and maintain physical fitness.<sup>52</sup> With these recommendations, HEPs become even more critical for patients healing from a musculoskeletal injury. Recent emphasis has been placed on patients taking responsibility for their own health and clinicians

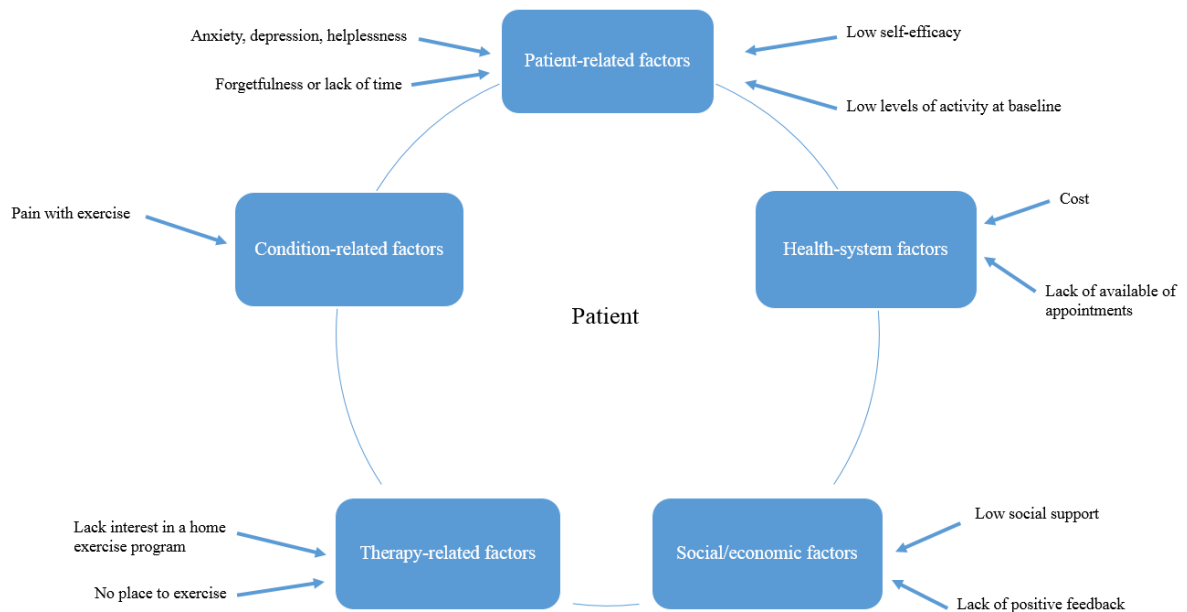
empowering patients to take control of their own lives.<sup>53</sup> Empowering patients to be advocates in their own care is vital for the success of rehabilitation and improving patient care.<sup>54</sup> Although there are numerous benefits to rehabilitation, patients tend to be non-adherent to the rehabilitation prescribed due to a variety of barriers.

#### Patient Adherence

One of the most significant issues facing rehabilitation clinicians is patients' lack of compliance or adherence to prescribed programs. Compliance is the act of following physicians' or clinicians' orders. Historically, the term compliance comes with negative connotations as it implies patients are compliant and submissive.<sup>55</sup> The term adherence is an alternative to the term compliance and is defined as the "the extent to which a person's behavior corresponds with agreed recommendations from a healthcare provider."<sup>1</sup> This gives patients a voice within the plan of care. The terms compliance and adherence are commonly used interchangeably but should be understood as two separate terms. Adherence is crucial to any medical or treatment regimen, as it has been identified as a precursor to improving patient-reported outcomes.<sup>13,14</sup> Unfortunately, adherence is not black and white or as simple as being just the patient's responsibility.

The World Health Organization (WHO) has indicated that adherence is multidimensional with five interacting parts including 1) social and economic factors, 2) therapy-related factors, 3) patient-related factors, 4) condition-related factors and 5) healthcare team and system-related factors (Figure 2.1).<sup>1</sup>

Figure 2.1. WHO 5 dimensions of adherence<sup>1</sup> and associated patient barriers



The first dimension, social and economic factors, such as age,<sup>25,32,56</sup> race,<sup>57</sup> living in poverty, lack of social support, unstable living conditions, the location of the clinic, or high cost of care, have been associated with poor adherence.<sup>1</sup> The second dimension, therapy-related factors, are specific to the care provided. Treatment regimens that are complex, timely, have frequent modifications or changes, and lack support are less likely to be followed.<sup>1</sup> Likewise, patients' attitudes, beliefs, expectations, knowledge, and resources also need to be managed and understood by the clinician as these patient-related factors may motivate or deter a patient from participating in a rehabilitation program. Condition-related factors also play a role in adherence to treatment. Condition-related factors may include symptom severity, the degree of disability, progression or regression of condition, and availability of care.<sup>1</sup> For example, Sluijs et al. discovered that patients who suffered trauma or had surgery were more likely to comply with rehabilitation compared to those with nonradiating back pain or multiple pathologies.<sup>10</sup> Lastly, the information available are more scarce on health care systems. Less is known about existing health care systems and its relationship to patient adherence. However, the clinician-patient relationship has been identified as a strong predictor of adherence throughout the years.<sup>1,10,58</sup> The stronger the relationship is between the clinician and patient, the more likely the patient is to adhere to treatment regimens. These five dimensions function simultaneously, making patient adherence a much more complicated part of patient care.

Patients' adherence, or lack of, to medical care has been studied extensively. To be non-compliant or non-adherent is failing to keep appointments or perform prescribed exercises.<sup>59</sup> Patient adherence varies as reported in the literature but is generally low. The current expectation is that our patients, regardless of their diagnosis, prognosis, or setting, will be non-adherent 15-50% of the time.<sup>11,55,60-62</sup> In rehabilitation specifically, reports of non-adherence up to 70% have been identified.<sup>10</sup> Practicing physical therapists have estimated that their patients are non-adherent to short-term exercise programs approximately 64% of the time and even less adherent to long-term programs.<sup>63</sup>

Poor adherence reduces the effectiveness of all medical treatments prescribed.<sup>1</sup> Patients who are non-adherent, may not regain range of motion or strength and have reports of lower health-related quality of life.<sup>60,64,65</sup> Non-adherence to medical advice is costly to not only the patient's health and outcomes but also to our healthcare system. Estimates in the hundreds of billions of U.S. dollars are spent due to patients' lack of adherence to prescribed medical regimens.<sup>18,46</sup> The WHO suggests that addressing this issue may be "the best investment" for combating chronic conditions.<sup>1</sup> In order to begin to improve patient adherence and reduce the debt it causes, reasons for patients' lack of adherence needs to be understood and investigated. Forkan et al. discovered that it is barriers, not motivators, that will predict patients' adherence to HEPs.<sup>19</sup>

### Barriers to Patient Adherence

A number of barriers to exercise rehabilitation adherence have been identified for in-clinic and home exercise. The medical literature has indicated over 200 factors that may play a role into patient adherence,<sup>10</sup> many of them fall within the five dimensions identified by the WHO and are related to the barriers described in this section. These barriers include but are not limited to anxiety, depression, helplessness, forgetfulness, low levels of activity at baseline, lack of interest in a HEP, lack of time, lack of positive feedback, low social support, no place to exercise, pain with exercise, and low self-efficacy.<sup>10,19,20,66,67</sup> These barriers have all been associated with lower levels of adherence to some degree (Figure 2.1).<sup>1,9,10,12</sup> Many of these barriers are out of reach for the clinician to influence, others fall within their scope and should be addressed to individualize patient care.

Anxiety and depression are conditions that should be treated regardless of other simultaneous conditions. Both high levels of anxiety and depression at baseline have predicted less adherence with exercise rehabilitation.<sup>25,68,69</sup> Post-surgical ACL patients have reported they do not complete their prescribed exercises due to negative moods.<sup>70</sup> Emotional states of patients



should not be ignored; however, rehabilitation clinicians may need additional training to address patient anxiety or depression and in many cases will need to refer out to a physician.

Lack of social support is detrimental to improving health and wellbeing, and the need of support is further increased when a patient is recovering from an injury and undergoing rehabilitation. The lack of social support is a potential barrier to rehabilitation adherence. In various patient populations, inadequate social support has been found to predict poor adherence to exercise rehabilitation.<sup>69,71</sup> On the other hand, those with sufficient social support have been found to adhere to the exercise rehabilitation prescribed.<sup>25,68</sup> As clinicians, we are able to provide social support to our patients in the clinic and can educate caregivers on how to do the same. Clinicians have the ability to provide encouragement and further guide patients to support groups or other medical providers the patient may need. Educating patients is an extremely important part of rehabilitation and in some instances may be just as important for the caregivers.

Helplessness is defined as the inability to act effectively, for many patients may feel the exercises prescribed will not help.<sup>10</sup> There is a strong body of evidence to support the idea that patients with strong feelings of helplessness are less adherent to exercise and home programs.<sup>10,72</sup> Additionally, patients that are not adequately supervised may become non-adherent further reflecting their helplessness and need for support quickly.<sup>10,73</sup>

Forgetfulness and lack of time are commonly discussed as barriers to patient adherence. A study surveying 1,681 patients found that non-compliant patients often report forgetting to exercise and a lack of motivation as barriers to exercising.<sup>10</sup> Similarly, patients often report not having enough time to attend rehabilitation or complete prescribed exercises at home.<sup>10,32,66</sup> Sluijs et al. reports patients deemed non-compliant reported they either lacked time to exercise or the exercises did not fit into their daily schedules.<sup>10</sup> Patients have even been found to report lack of time as a reasons for non-adherence despite actually having enough time.<sup>66</sup> In addition, patients given too many exercises at once have been found less likely to be adherent.<sup>70,74</sup> Older adults that were given home exercises were more compliant when they were given 2 verses 8 exercises ( $H = 6.195$ ,  $df = 2$ ,  $p = 0.046$ ).<sup>75</sup> Possible solutions to these barriers include setting up reminders for patients and/or incorporating exercises into daily routines while limiting the number of exercises prescribed.

Lack of positive feedback is another barrier to patient adherence. Compliance has been found to be significantly related to receiving positive feedback in patient reports.<sup>10</sup> Sluijs et al. found that patients who knew their clinician were satisfied with their exercise performance had

higher rates of compliance compared to those who were not provided similar feedback.<sup>10</sup> Addressing this barrier can be easily accomplished by incorporating positive feedback into daily practice.

One of the primary reasons patients seek medical attention is due to pain. Pain is a subjective experience; different for each individual and not surprisingly a barrier to exercise rehabilitation adherence. Research has suggested that patients with higher pain at baseline spend less time engaged in exercise designed to improve their condition.<sup>69,76</sup> Patients themselves have reported that pain, or even the fear of pain, keeps them from completing their prescribed exercises.<sup>10,32</sup> Other studies have found a reduction in pain following exercise is positively correlated with better adherence to exercise long-term.<sup>68</sup> This suggests that if exercise can decrease pain and is deemed useful by the patient, adherence may increase.

Self-efficacy refers to one's belief in their ability to successfully complete a task and is strongly related to patient adherence to exercise rehabilitation. Various studies have indicated that low levels of self-efficacy are detrimental to exercise rehabilitation adherence,<sup>12,29,71</sup> whereas high levels of self-efficacy predict higher rates of adherence to HEPs and exercise long-term.<sup>77-79</sup> Grindley et al. discovered that of all the barriers addressed, self-efficacy accurately differentiated patients who were more adherent to exercise from those who were non-adherent to rehabilitation, indicating the ability to predict those who would be non-adherent.<sup>32</sup> A moderate correlation was found between self-efficacy and adherence using the Sport Injury Rehabilitation Beliefs Scale. A model aimed to predict adherence included self-efficacy, age, positive and negative effect and was able to classify 63.9% of adherent and non-adherent cases.<sup>32</sup> Associations have also been found between low levels of self-efficacy, higher anxiety, pain, and disability.<sup>47,80</sup> Understanding that some of these barriers overlap and may affect each other simultaneously could be helpful to rehabilitation clinicians.

Low social support, forgetfulness, lack of positive feedback, pain with exercise, and low self-efficacy are some of the barriers clinicians may be able to address within their practice, without additional training. Of the barriers clinicians may be able to impact, self-efficacy is the focus of this literature review. Theoretically, by addressing a patients' self-efficacy, other barriers to patient adherence may be addressed simultaneously. For example, higher levels of self-efficacy have been found to be associated with lower levels of musculoskeletal pain.<sup>22,81</sup> Therefore, if clinicians can positively influence a patient's self-efficacy, they may see an associated decrease in pain levels. Before addressing self-efficacy in practice, it is essential to understand the theory and its foundations.

## Social Cognitive Theory and Self-Efficacy

Social Cognitive Theory (SCT), derived from Miller and Dollard's 1941 Social Learning Theory, incorporates the importance of observational learning and vicarious reinforcement in human growth.<sup>82</sup> In 1986 Albert Bandura differentiated SCT from Social Learning Theory by emphasizing that cognition is crucial for human functioning, specifically for one's capability to self-regulate, take action, and comprehend reality;<sup>27</sup> each of which is critical for patients following injury. Compared to Social Learning Theory, SCT provides a broader description of how social experiences affect learning. Within SCT individuals are viewed as capable of contributing to their circumstances, rather than being bystanders in their surroundings and impacted by environmental influences.<sup>27,83</sup>

### *Constructs of Social Cognitive Theory*

Triadic reciprocal determinism, the foundation of SCT, is the dynamic process where personal factors (such as cognition, affect, and biological events), behavior (one's actions), and the environment (physical and social) influence one another.<sup>27</sup> When one of these factors change, the others will be influenced. For example, an athlete may have the belief that they will succeed in returning to their sport following injury (personal factor) and the rehabilitation training room is clean, neat, orderly, and the rehabilitation clinician is supportive of their needs (environment). The combination of personal factors and environment may influence this patient's behavior during rehabilitation including their adherence to rehabilitation. The environmental influence not only comes from the physical environment but the social environment as well. In healthcare, the physical environment may be the clinic or rehabilitation facility, and the atmosphere created by the clinician may stand as the social environment. The atmosphere created by the clinician should be a positive, welcoming environment where a patient feels safe. Both the physical environment and the atmosphere may influence personal behavior and action during rehabilitation. Within this model, these elements work together, where human action must incorporate human agency and self-regulation.<sup>84</sup> The clinician's understanding of these inter-workings may lead to a better understanding of a patient's action and motivation.

### *Human Agency and Self-Regulation*

Having the ability to react and respond to environmental surroundings, or human agency is another essential foundational tenet of SCT. Through human agency, the human brain is considered "generative, creative, proactive, and self-reflective not just reactive," giving the individual the ability to adapt to ever-changing situations.<sup>85</sup> Intentionality, forethought, and self-

reactiveness are components of human agency that allow individuals to make decisions about their own actions. Intentionality allows individuals to form action plans and strategies for accomplishing a task. The patient's thoughts about making a rehabilitation appointment or following up with their clinician to continue with exercises shows an intention to act. Forethought follows human intentions as the next step towards action. Forethought allows individuals to set goals and anticipate outcomes to guide their efforts. Patients may set the goal of increasing range of motion to improve their activities of daily living or return to sport. Self-reactiveness is what allows individuals to execute their actions.<sup>86</sup> The physical act of attending rehabilitation and completing rehabilitation sessions reflects self-reactiveness. Self-reflectiveness and self-regulation also fall under the domain of human agency and self-regulation. Self-regulation is constructed individually and derives from not only the environment but even more so from human experiences.<sup>84</sup> Based on experiences, successes and/or failures, individuals have the ability to make adjustments through thought and self-regulation.

### *Self-Efficacy*

Bandura states self-efficacy "is the foundation of human agency."<sup>85</sup> Self-efficacy is defined as the belief in one's capability to complete a certain task.<sup>23,24</sup> Such beliefs play an important role in the way individuals behave and what motivates them.<sup>23</sup> Efficacy beliefs can either be self-hindering or enhancing depending on whether the individual has pessimistic or optimistic thoughts.<sup>87</sup> Self-efficacy beliefs are an important construct for determining possible reasons why a patient is not returning for subsequent rehabilitation sessions. This is particularly true given the research suggesting low self-efficacy is a barrier to rehabilitation adherence. In a study aiming to examine the effects of threat and coping appraisal on compliance to sports therapy modalities and rest, Taylor and May only identified two significant predictors. Using the Sports Injury Beliefs Survey and both the patient and clinicians estimates of rehabilitation compliance, Taylor and May found severity of injury and patient's self-efficacy estimated compliance to patient prescription over any other factors.<sup>29</sup> The level of self-efficacy one possesses is indicative of the amount of effort they put forth to complete a task and the degree to which that effort will be sustained.<sup>88,89</sup> Self-efficacy can influence an individual's decision to participate in activities he or she is comfortable and confident with and avoid those they are not.<sup>23,90</sup> If our patients have low self-efficacy for exercise they may avoid rehabilitation altogether. According to Bandura,<sup>23</sup> the higher the sense of self-efficacy, the more likely the task will be seen as a "challenge to be mastered" and not one to be avoided. In education, college students' self-efficacy judgments and performance have found to have strong positive associations ( $r = 0.63$ ,  $p$

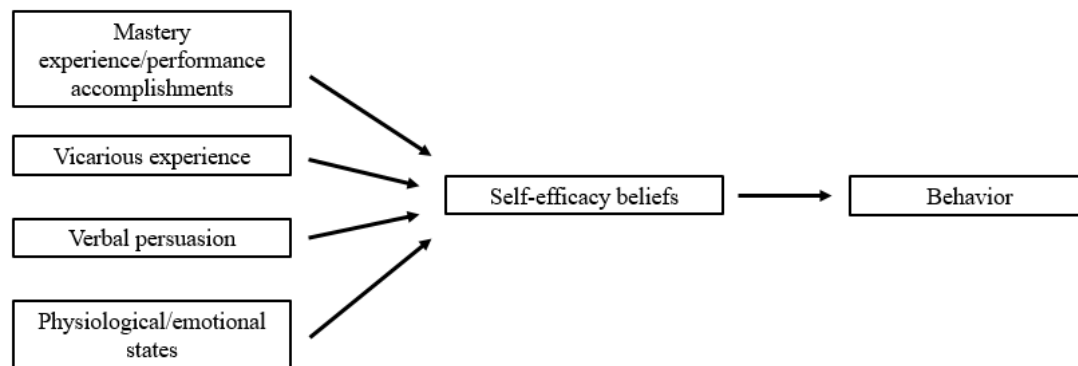
< 0.001) indicating higher self-efficacy yields problem-solving success, higher grades, and persist longer in science majors.<sup>91,92</sup> Persons with higher self-efficacy also tend to set more challenging goals and recover more quickly from setbacks or failures, as compared to individuals with lower self-efficacy.<sup>23</sup> For example, persons with lower self-efficacy have a tendency to walk away from difficult tasks, give up easily, abandon goals, and dwell on deficiencies.; they are also more likely to become stressed and depressed.<sup>23</sup> Self-efficacy is task and situation specific, meaning that the self-efficacy of a task will depend on it's similarity to previous tasks and may or may not transfer.<sup>93</sup> For example, if a patient has previously been successful in returning to activity following surgery, then they may have higher levels of self-efficacy when going through a similar procedure or rehabilitation program later in life. In contrast, patients whose experiences were less positive may be hesitant or withdrawn from the rehabilitation tasks provided to them.

#### *Sources of Self-Efficacy*

Self-efficacy is not stagnant; it changes with time, observation, and experience. Bandura explains the four sources of self-efficacy that contribute to one's belief in their success in accomplishing a task. The four sources that develop self-efficacy include 1) mastery experience, 2) vicarious experience, 3) verbal persuasion, and 4) physiological or emotional state. (Figure 2.2) Of the four sources, improving self-efficacy through mastery experience is reported to be most effective.<sup>23,24</sup> Mastery experiences are built on one succeeding or failing during a particular task. Bandura suggests that successes build a strong belief in ability; failures, especially if they occur before efficacy is established, can undermine that potential ability.<sup>23</sup> Successful completion of a task can increase one's perceived capability while shortcomings may be detrimental to one's self-efficacy. Social models are a critical component to vicarious experience, the second means of strengthening self-efficacy. Observation of others succeeding or failing during a specific task may either increase or decrease an individual's perception of their abilities.<sup>23</sup> Models that one perceives to resemble their own may have a more significant impact on self-efficacy than one perceived as different.<sup>23</sup> Verbal persuasion, also known as social persuasion, provides encouragement towards successful task completion. Positive verbal persuasion, or reinforcing the idea that one does indeed possess the capabilities to accomplish a specific task may increase the effort put forth to complete the task.<sup>23</sup> On the contrary, those who are persuaded that they lack the ability to complete a task end up avoiding it altogether and give up quickly when challenges are encountered.<sup>23</sup> Lastly, physiological or emotional states also impact one's perceived self-efficacy. By altering an individual's physiological state by reducing stress or negative emotions self-efficacy for rehabilitation can be increased.<sup>23</sup> Understanding the sources of self-efficacy and how

they may be incorporated into patient care can aid in improving practice. The relationship between self-efficacy and patient adherence have been established, yet implications of use in clinical practice, specifically assessment, is less known. Assessment of self-efficacy is vital if clinicians plan to use the already identified successful interventions to improve self-efficacy.

Figure 2.2 Bandura's sources of self-efficacy information



#### The Relationship between Patient Adherence and Self-Efficacy

The relationship between patient adherence and self-efficacy has been well established and is one that the clinician and patient can work on together. One study reported that patients with low self-efficacy were 7.4 times more likely not to adhere to prescribed medical regimens.<sup>94</sup> Systematic reviews in various patient populations have found that high self-efficacy yields greater adherence to exercise rehabilitation programs,<sup>95</sup> and is a predictor of exercise compliance.<sup>12,96</sup> It has been suggested that targeting a patient's self-efficacy and working to enable their self-motivation can improve adherence to rehabilitation.<sup>97</sup> Levy et al.<sup>97</sup> examined an adapted psychosocial model to predict adherence to sports rehabilitation. Patients with a tendon-related injury seeking care at a physiotherapy clinic completed a battery of questionnaires pre- and post-treatment, including the Sports Injury Beliefs Survey and measures of adherence. A regression analysis indicated that self-efficacy, motivation, and a patient's intentions significantly predicted in-clinic adherence.<sup>97</sup> Studies have incorporated and examined self-efficacy interventions in a number of patient populations to improve exercise adherence including patients with heart failure,<sup>33,38</sup> chronic obstructive pulmonary disease,<sup>34</sup> cancer,<sup>35</sup> but minimally in those with musculoskeletal injury.<sup>39</sup> Self-efficacy has been shown to mediate behavioral change when focusing on improving exercise adherence in patients with chronic obstructive pulmonary

disease.<sup>34</sup> In patients with heart failure, a large body of literature exists to promote the use of self-efficacy interventions to improve adherence to exercise rehabilitation.

Interventions geared towards improving self-efficacy have also shown to increase adherence to rehabilitation exercise. A systematic review of interventions to increase exercise self-efficacy among heart failure patients found that the most utilized strategies included patient education, self-monitoring, motivational interviews, self-management, feedback, problem-solving, and goal setting.<sup>33</sup> These interventions were then categorized by the source of self-efficacy. Mastery experience, learning by doing, was found to effectively increase self-efficacy in patients who were unable to complete high-intensity exercises due to a medical limitation. By directly participating in the practice of exercise, self-efficacy for exercise will increase. This might be applied in musculoskeletal rehabilitation having a patient complete an exercise without a load initially to ensure proper performance and effectively build self-efficacy for exercise during rehabilitation. Vicarious experience of a successful model also has implications for exerting a positive influence on self-efficacy. Role modeling through team exercise or directly from a clinician has been shown to increase self-efficacy by integrating social comparison, exchange, and learning.<sup>98</sup> For example, a clinician might have patients watch them successfully complete an exercise before having the patient attempt the activity. Additionally, verbal persuasion through feedback about exercise from an expert source or motivational interviewing has also been found to be successful strategies for improving patient self-efficacy for exercise. Lastly, patient assessment education and recognition of physiological responses were identified as another method to increase patient self-efficacy via the physiological state.<sup>33</sup> Although the incorporation of self-efficacy related interventions has been implemented successfully within cardiac rehabilitation, there is limited research examining self-efficacy interventions within musculoskeletal rehabilitation.

#### Self-Efficacy in Musculoskeletal Rehabilitation

Much of the current literature in the musculoskeletal domain examines patients with low back pain and evaluates self-efficacy as a secondary outcome measure or as a mediator of function. A study of patients with low back pain examined the extent to which pain self-efficacy and fear of movement mediate the relationship of other outcomes. They found that improvements in pain self-efficacy were identified to be a better mediator of pain and function than fear of movement in those with low back pain over time.<sup>21</sup> The results of the regression models with disability, pain self-efficacy, and fear of movement as variables, pain self-efficacy as a mediator resulted in explaining 9.9-14.7% of the models, whereas when fear was used as the mediator only

1.0-2.9% of the variance in the model was explained.<sup>21</sup> Results suggested a focus on improving self-efficacy might be more effective than reducing the fear of movement.

Research has focused on interventions to improve self-efficacy. Studies have sought to determine the effectiveness of a goal setting intervention to increase self-efficacy and adherence to rehabilitation in patients with low back pain.<sup>39</sup> Other studies have used some form of cognitive-behavioral training,<sup>42,99</sup> or motivational enhancement therapy, in addition to physical therapy, to increase patient adherence to exercise.<sup>100</sup> Successful interventions for improving self-efficacy included: cognitive-behavioral therapy when paired with the standard of care<sup>42</sup> and patient goal setting.<sup>39</sup> Goal setting interventions consisted of setting short and long-term goals based on patient-clinician collaboration. Effective interventions focused on improving self-efficacy through the four sources: mastery experience, verbal persuasion, vicarious experience, and physiological state. Though clinical research has yielded effective interventions for increasing a patient's self-efficacy for exercise,<sup>33</sup> as of yet, little evidence is available to indicate that clinicians are evaluating self-efficacy as part of their standard of care. To this end, reliable and valid measures of patient self-efficacy are essential in order to identify if improvements have been made.

#### Self-Efficacy Assessment

Self-efficacy is dynamic and changes based on situation and task, it is not a global trait.<sup>101</sup> Although a General Self-Efficacy scale has been established, according to Bandura, there is no all-purpose measure for self-efficacy.<sup>101</sup> Based on the outcome of interest, questionnaires and scales need to be reflective of the task and situation at hand. These scales are commonly used to either predict another outcome based on initial levels of self-efficacy or to determine if an intervention has the ability to improve self-efficacy over time. Questionnaires that have been utilized in the rehabilitation and exercise self-efficacy realm include, but are not limited to, the Barriers Self-Efficacy Scale,<sup>102,103</sup> Exercise Cardiac Self-Efficacy,<sup>104</sup> Sports Injury Rehabilitation Beliefs Survey,<sup>29,40,97,105</sup> Self-Efficacy for Exercise,<sup>98,106</sup> Exercise Self-Efficacy,<sup>107-109</sup> Self-Efficacy Expectations Scales,<sup>110</sup> Pain Self-Efficacy Questionnaire and Pain Rehabilitation Expectations Scale.<sup>100</sup> Administrators of these scales need to understand the reliability, validity, and limitations of their use. The difficulty with many of these scales is that they have been utilized and validated in only specific patient populations tasks. As HEPs are a critical component of rehabilitation, one may expect to find a scale that assesses a patient's self-efficacy for HEPs. It is currently unclear if clinicians use any of these scales in clinical practice to aid in individualization of treatment or if a self-efficacy scale for HEPs exists.



## Conclusions

Musculoskeletal rehabilitation is critical to return patients to normal function. Billions of dollars are spent on musculoskeletal injuries<sup>4</sup>, but there appears to be a significant issue in not getting patients back to full function. One major contributor to poor patient outcomes is poor adherence to rehabilitation exercise programs. There are several contributors that affect adherence to a rehabilitation exercise program. Self-efficacy is one factor that can be affected by the rehabilitation clinician and has demonstrated the effect on exercise adherence in other health conditions<sup>33</sup>, but to date, limited information exists on applications to musculoskeletal rehabilitation. It has been observed that low self-efficacy is associated with greater disability<sup>47</sup>, but it has not been well established if self-efficacy is useful for increasing home exercise rehabilitation adherence. There is not yet a clear understanding of whether self-efficacy is even being considered when evaluating a patient before prescribing home exercises. Currently unknown is whether or not a standard measure of self-efficacy has been used to assess self-efficacy in patients with musculoskeletal conditions. Further, the extent to which clinicians are evaluating patient self-efficacy and the barriers patients confront that impact exercise adherence. If a tool is not well established then devising such a tool to evaluate self-efficacy for HEPs could significantly impact patient adherence to HEPs thereby improving outcomes and reducing costs.

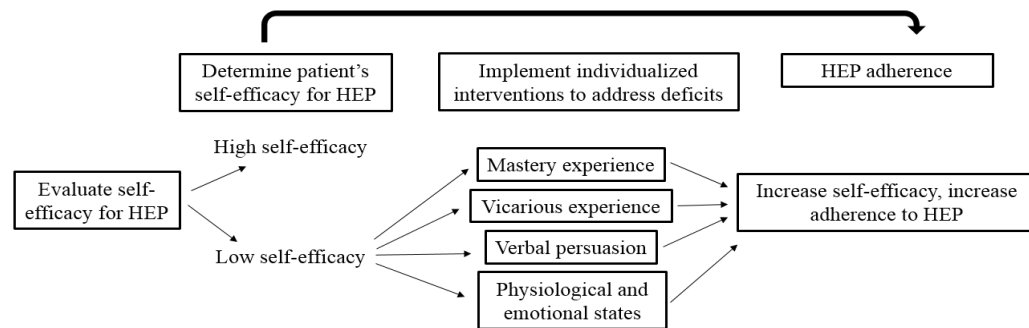
### **Chapter 3: Measurements of Self-Efficacy in Musculoskeletal Rehabilitation: a Systematic Review**

#### **Introduction**

Musculoskeletal injuries requiring rehabilitation affect a significant portion of the population every year. Although these injuries may be debilitating, researchers have found that patients are non-adherent to their rehabilitation programs approximately 50% of the time.<sup>10,11</sup> In addition to in-clinic rehabilitation sessions, home exercise programs (HEPs) are utilized to promote healing. The benefits of HEPs include range of motion and strength gains, reinforcement of motor learning, and pain reduction and improvements in function.<sup>8,9</sup> Unfortunately, the literature suggests that patients are non-adherent to these programs as often as 70% of the time.<sup>10,12</sup> Researchers have examined the barriers to patient adherence to HEPs, which include low physical activity levels at baseline, depression, anxiety, helplessness, forgetfulness, increased pain levels during exercise, and low self-efficacy.<sup>20</sup> Among these psychological barriers to adherence, a patient's level of self-efficacy toward performing exercises at home is most readily influenced by the clinician.

Self-efficacy is defined as one's belief in his or her capability to succeed in completing a specific task.<sup>24,111</sup> Self-efficacy has been shown to influence behaviors, choice of activities, and level of achievement.<sup>111</sup> Bandura<sup>24</sup> contended that "people's level of motivation, affective states, and actions are based more on what they believe than on what is objectively true." That is, if patients do not believe they can successfully complete their HEPs, they may not even attempt the prescribed exercises. Self-efficacy also predicts how much effort people put forth towards a task.<sup>89</sup> Researchers have suggested that clinicians who assess a patient's self-efficacy prior to prescribing the HEP, can better adjust and individualize these programs in ways that are supportive of a patient's perceived efficacy.<sup>2</sup> In their theoretical model, Picha and Howell proposed that if self-efficacy for HEPs is addressed initially, a patient's adherence to the prescribed program would increase (Figure 3.1).<sup>2</sup>

Figure 3.1. Modified self-efficacy model for improved adherence to HEPs<sup>2</sup>



Researchers investigating treatment methods have used a variety of measures to evaluate self-efficacy, including general perceptions, exercise-specific judgments, and perceived efficacy for pain management.<sup>39,112,113</sup> Self-efficacy is task-specific; therefore, the measure used to assess this construct should differ based on the clinician or researcher's clinical question. Scales have been developed to study certain patient populations and specific tasks. For example, cardiac rehabilitation research has evaluated self-efficacy extensively and has incorporated findings into clinical practice. Rajati et al.<sup>33</sup> conducted a systematic review to examine the effect of interventions to improve exercise self-efficacy in patients with heart failure. Interventions that included the sources of self-efficacy were found to improve confidence, increase ability to initiate exercise, and reduce symptoms.<sup>33</sup> Self-efficacy outcome measures used in cardiac rehabilitation included the Barriers Self-Efficacy Scale, Exercise Self-Efficacy Scale, Barnason Efficacy Expectation Scale,<sup>114</sup> Exercise Cardiac Self-Efficacy, Self-Efficacy Scale, Cardiac Exercise Self-Efficacy Questionnaire,<sup>115</sup> and Self-Efficacy Expectations Scale.<sup>33</sup> Because self-efficacy is task and situation-specific, these measures may not be applicable to a patient with a musculoskeletal injury performing a HEP.

Self-efficacy has been studied interminably within cardiac rehabilitation, but less so for patients undergoing musculoskeletal rehabilitation. Initial evidence shows that interventions targeting self-efficacy are successful in individuals with low back<sup>116</sup> and knee pain.<sup>117</sup> However, unknown is what scales are being used to evaluate self-efficacy, what psychometric properties have been established, and if they are able to predict rehabilitation exercise adherence. Therefore this systematic review has four primary aims and one secondary aim: (1) determine what self-efficacy scales are being used in conjunction with exercise adherence; (2) identify if any self-efficacy scale has been developed to specifically assess self-efficacy for HEPs; (3) determine the psychometric properties of each scale identified; and (4) determine which scales are being used to predict adherence to rehabilitation exercise. Lastly, a secondary aim is to examine which scales

have measured improvements in self-efficacy over time using interventions that specifically target self-efficacy.

## Methods

### *Search Criteria and Strategy*

This study used the PRISMA 2009 checklist as a guide for conducting this study. Articles were retrieved in November of 2017 by searching online databases. The databases searched included CINAHL, MEDLINE, PubMed, PsycINFO, and Sport Discus. All databases were searched using specific search terms. The terms and strategy are displayed in Table 3.1.

The following inclusion and exclusion criteria were agreed upon and used by reviewers:

Articles were included in this review if all of the following criteria were met:

- Articles in English.
- Randomized clinical trials, studies of level three evidence or greater according to the Oxford Centre for Evidence-Based Medicine, 2011.
- Patient populations suffering from a musculoskeletal injury, pain, or disorder.
- Reports rehabilitation exercise adherence.
- Reports patient's self-efficacy.

Articles were excluded if any of the following were true:

- Articles not in the English language.
- Commentary or editorials.
- Studies that involve children or adolescents, prevention measures, cancer, opioid or drug use, and pregnancy.

Table 3.1 Terms and database results

Search	Terms	Cinahl	Medline	Sport discus	PsycINFO	PubMed
1	Musculoskeletal patients OR musculoskeletal pain OR musculoskeletal injury OR musculoskeletal disorder OR orthopedic patients OR orthopedic injury OR orthopedic pain OR orthopedic disorder	10,352	17,169	7,012	5,806	1,100,225
2	Patient compliance OR patient adherence OR compliance OR adherence OR rehabilitation adherence OR rehabilitation compliance	266,423	1,028,433	47,801	190,846	1,029,444
3	Self-efficacy OR self-confidence OR efficacy OR confidence OR efficacy beliefs	64,052	241,404	9,638	54,350	245,354

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Table 3.1 (Continued)

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4	Combine searches 1, 2, and 3 with the term “AND” with the following limits terms children, cancer, breast cancer, adolescents, cardiac, heart failure, drug, medication, diabetes, and post-traumatic stress disorder	54	46	24	23	427
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#### *Article Quality Evaluation*

Two reviewers used the Modified Downs and Black<sup>118,119</sup> (tool located in Appendix 1) quality assessment tool to independently review the full text articles. This tool was created to assess both randomized control trials, non-randomized control trials, and observational studies in the health care field. For each question in the assessment tool, a score of a 0 (no, not present) or 1 (yes, present) was given.

#### *Data Extraction*

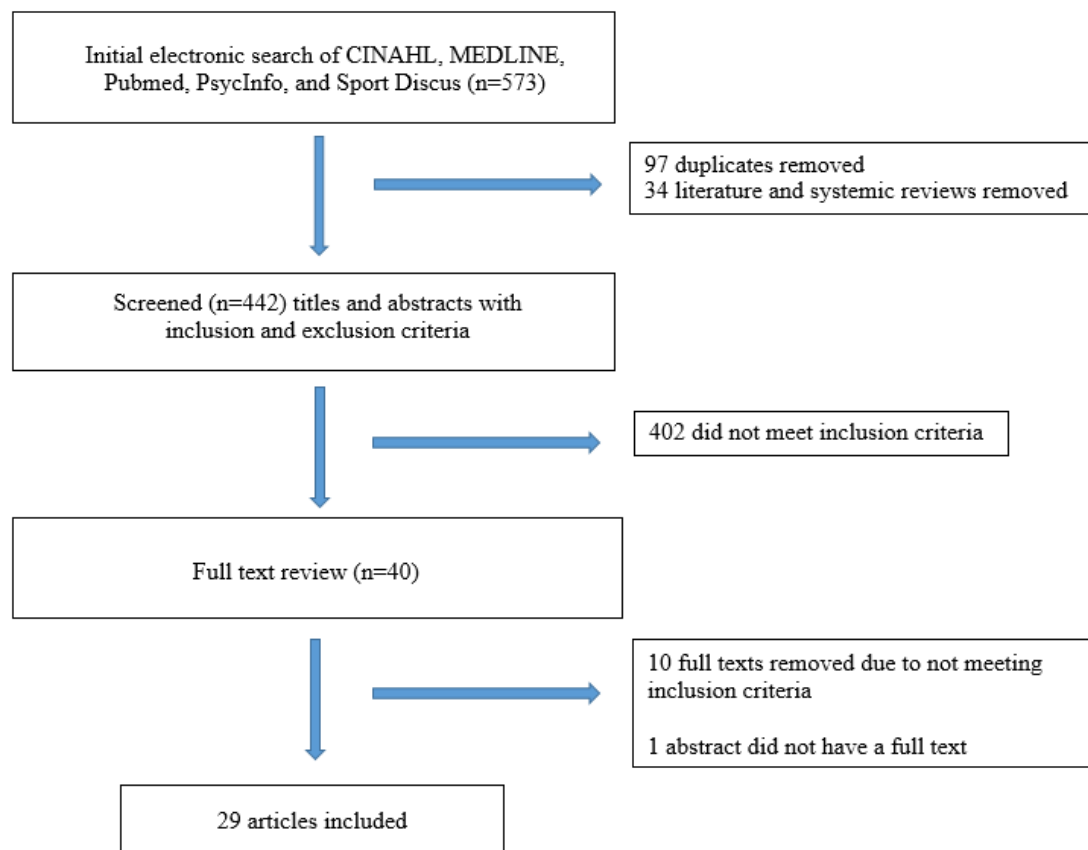
The following components were extracted from the full text articles: study sample population, type of self-efficacy measurement used, study quality as identified with the Modified Downs and Black, results pertaining to self-efficacy, and level of evidence (LOE). LOE was based on the Oxford Centre for Evidence-Based Medicine (2011). A standardized template was used to extract all data. The psychometric properties of the instruments were recorded if previously established. Reliability and validity were extracted to determine the strengths and weakness of the scales when assessing self-efficacy for exercise in patients suffering from a musculoskeletal injury, disorder, or pain. When this information was not provided, we completed

an additional search in order to collect this information. The same databases were used to search for the scales psychometric properties or scale development if not reported in the included study. No statistical analyses were conducted within this review.

## Results

The initial search produced 547 citations. After removal of 97 duplicates and 34 review articles from the multiple databases searched, two authors reviewed the remaining 442 titles and abstracts. The level of agreement for this process was 95% ( $\kappa = 0.73$ ). The reviewers identified 23 articles with disagreement regarding inclusion. A third independent reviewer made a final decision on whether or not to include these 23 articles. Of the 23, 11 were included. There were 402 articles that did not meet the inclusion criteria leaving 40 full text articles to review. Of the remaining articles, one was removed because a full text could not be located and 10 were removed because they did not meet inclusion criteria or did not provided self-efficacy data upon full text review. Twenty-nine articles were included in the full-text methodological review process and included in this systematic review (Figure 3.2).

Figure 3.2. Systematic search strategy



### *Methodological Quality*

Table 3.2 displays the results of the methodological assessment using the Downs and Black quality assessment tool. Two reviewers scored the 29 studies and were in agreement on 28. A third reviewer assessed the article for which the reviewers disagreed and assigned a quality score. The majority of studies were lacking information on the population in which their study sample came from (Questions 7 and 8) and whether the outcome measures used were reliable which are represented in the last question of the Downs and Black tool.



Table. 3.2 Methodological quality of included studies

Study	Downs and Black Questions										Quality Score
	1	2	3	4	5	6	7	8	9	10	
Grindley et al. <sup>32</sup>	1	1	1	1	1	1	1	1	1	1	10
Hammond et al. (1999) <sup>120</sup>	1	1	1	1	1	1	1	1	1	1	10
Nordin et al. <sup>121</sup>	1	1	1	1	1	1	1	1	1	1	10
Skolasky et al. <sup>122</sup>	1	1	1	1	1	1	1	1	1	1	10
Bearne et al. <sup>123</sup>	1	0	1	1	1	1	1	1	1	1	9
Hammond et al. (2004) <sup>124</sup>	1	1	1	1	1	1	1	1	1	0	9
Palmer et al. <sup>41</sup>	1	1	1	1	1	1	1	1	1	0	9
Stenstrom et al. <sup>77</sup>	1	1	1	1	1	0	1	1	1	1	9
Williamson et al. <sup>125</sup>	1	1	1	1	1	1	1	1	1	0	9
Baker et al. <sup>126</sup>	1	1	1	1	1	1	0	1	1	0	8
Cheung et al. <sup>127</sup>	1	1	1	1	1	1	0	0	1	1	8
Dalager et al. <sup>96</sup>	1	1	1	1	1	0	1	1	1	0	8
Gowans et al. <sup>128</sup>	1	1	1	1	1	1	0	0	1	1	8
Hammond et al. (2004) <sup>129</sup>	1	1	1	1	1	1	0	0	1	1	8
Kang et al. <sup>130</sup>	1	1	1	1	1	1	0	0	1	1	8
King et al. (2008) <sup>131</sup>	1	1	1	1	1	1	0	0	1	1	8
Schachter et al. <sup>132</sup>	1	1	1	1	1	1	0	0	1	1	8
Baxter et al. <sup>133</sup>	1	1	1	1	1	1	0	0	1	1	8

<b>Table 3.2 (Continued)</b>											
<b>Taylor et al.<sup>134</sup></b>	1	1	1	1	1	1	0	0	1	1	8
<b>Hughes et al. (2004)<sup>135</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Hughes et al. (2006)<sup>136</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>King et al. (2002)<sup>137</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Levinger et al.<sup>43</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Mannion et al.<sup>138</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Skou et al.<sup>139</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Oliver et al.<sup>25</sup></b>	1	1	1	1	1	0	0	0	1	1	7
<b>Rini et al.<sup>140</sup></b>	1	1	1	1	1	1	0	0	1	0	7
<b>Andersen et al.<sup>76</sup></b>	1	1	1	1	1	0	0	0	1	0	6
<b>Chen et al.<sup>78</sup></b>	1	1	1	1	1	0	0	0	1	0	6

\*0 = no; 1= yes

1. Is the hypothesis/aim/objective of the study clearly described?
2. Are the main outcomes clearly described?
3. Are the characteristics of the patients included in the study clearly described?
4. Are the main findings clearly described?
5. Does the study provide estimates of the random variability in the data for the main outcomes?
6. Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?
7. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?
8. Were those subjects who were prepared to participate representative of the entire population from which they were recruited?
9. Were the statistical tests used to assess the main outcomes appropriate?
10. Were the main outcome measures used accurate (valid and reliable)?

Table 3.3 Studies that used self-efficacy to predict adherence

Author	Purpose	Population	SE Scale	Adherence Measure	Results/ Conclusions	LOE
Andersen <sup>76</sup>	Determine the influence of exercise self-efficacy on adherence to workplace exercise among office workers.	Office workers with a history of frequent neck/shoulder pain (n = 132)	Self-Efficacy for Physical Activity	Patient self-report log	Low (odds ratio = 0.07, 95% CI: 0.02-0.25) to medium (odds ratio = 0.19, 95% CI: 0.07-0.49) exercise self-efficacy was a significant predictor of low adherence. Exercise self-efficacy was a predictor of adherence to a 10-week exercise program.	2
Chen <sup>78</sup>	Investigates how self-efficacy may influence compliance with HEPs.	Upper extremity impairment (n = 62)	Health belief model	Patient self-report	Self-efficacy was significantly associated with compliance (r = 0.30, p < 0.05), perceived barriers (r = -0.36, p < 0.01), and perceived benefits (r = 0.47, p < 0.001). A stepwise regression analysis perceived self-efficacy significantly contributed to compliance (B (SE) = 7.05 (2.60) beta = 0.33). Self-efficacy is a significant predictor of compliance with HEPs.	3

Table 3.3 (Continued)

Cheung <sup>127</sup>	To report the relationship between Social Cognitive Theory constructs and yoga adherence.	Knee OA (n = 36)	Self-Efficacy for Exercise scale	Class attendance and self-report log	Average SEE score = $72.0 \pm 16.8$ indicating participants were confident that they would be able to continue practicing yoga in the face of barriers. The SEE score was positively correlated with class attendance during the intervention period ( $r = 0.34$ , $p = 0.03$ ) but not home practice ( $r = 0.14$ ). High self-efficacy scores at baseline were positively associated with class attendance.	2
Dalager <sup>96</sup>	Exercise self-efficacy was analyzed for predictive values of compliance to the strength training intervention.	Musculoskeletal pain of neck or shoulder (n = 573)	Self-Efficacy for Physical Activity	Self-report log	Compliant participant's self-efficacy did not change from baseline to follow-up for any group, however, when all training groups were collapsed together, those with low self-efficacy at baseline (47.7%) increased at follow-up (56.4%). A linear regression determined rating self-efficacy as high at baseline was positively associated with compliance. Exercise self-efficacy is a significant predictor of compliance.	2

Table 3.3 (Continued)

Grindley <sup>32</sup>	Examine the utility of a screening tool (that includes SE) in the prediction of adherent behavior.	Musculoskeletal injury (n = 229)	SIRBS	Attendance ratio and SIRAS	The final prediction model include self-efficacy (r = 0.39) and correctly identified 63.9% of adherent and non-adherent cases. Self-efficacy differentiated between those who were more and less adherent.	3
Kang <sup>130</sup>	Examined the influence of self-efficacy to exercise on long-term adherence to an aquatic program.	RA (n = 72)	Aquatic ESE	Weekly attendance at the pool and	Exercise self-efficacy in the adherent group was significantly higher (mean = $80.7 \pm 14.0$ ) compared to the non-adherent group (mean = $60.3 \pm 25.7$ , $p < 0.0001$ ). Exercise self-efficacy was significantly higher in the adherent group.	3
Mannion <sup>138</sup>	Evaluate the influence of various cognitive factors and beliefs on adherence to the exercise program.	Chronic low back pain (n = 37)	ESE	Self-report log	Baseline self-efficacy was $47.4 \pm 13.3$ (range = 21-66). Exercise self-efficacy was found to be correlated with adherence (Rho = 0.36, $p = 0.045$ ). A linear regression analysis of gender and self-efficacy together were significant predictors of adherence and accounted for 32% of the variance. Self-efficacy was the only psychological variable that explained a significant proportion of the variance in the model.	3

Table 3.3 (Continued)

Oliver <sup>25</sup>	To identify predictors associated with the initiation and maintenance of regular exercise.	FM (n = 444)	ASES (mod) and ESE	Exercise behavior question (yes/no)	Higher exercise self-efficacy was significantly related to engaging in exercise behavior at baseline assessment (B = 1.45, SE=0.18, p < 0.01, exp (B) = 4.28) at 6 months (B = 1.01, SE = 0.16, p < 0.01, exp (B) = 2.74), and at one year (B = 1.24, SE = 0.17, p < 0.01, exp (B) = 3.44).	2
Skolasky <sup>122</sup>	Determine the association between baseline self-efficacy and participation in therapy post-op.	Degenerative lumbar spinal stenosis (n = 65)	ASES (mod)	Attendance based on self-reporting	Within two regression models, self-efficacy to participate in physical therapy was the largest psychological variable to change ( $\beta$ -coefficient 12.04-9.07, p < 0.001). Increased self-efficacy was associated with greater adherence to physical therapy.	3
Stenstrom <sup>77</sup>	To identify predictors for compliance with the long-term. home exercise regimens.	Inflammatory rheumatic disease (n = 54)	Self-Efficacy for Exercise Scale	Self-report logs	Non-compliers had lower self-efficacy for exercise (median 50 vs 85, p < 0.01). A logistic regression found self-efficacy contributed significantly to the model ( $\beta$ = 0.0523, OR = 1.05, 95% CI: 1.02-1.09). Compliance with the 1 year exercise regimen was predicted by high exercise self-efficacy.	2

\*Population: FM= Fibromyalgia, OA= Osteoarthritis, RA= Rheumatoid arthritis; mod = modified version

\*Scales: ASES= Arthritis Self-efficacy Scale, PSEQ= Pain Self-Efficacy Questionnaire, GSE= general self-efficacy scale

Table 3.4 Studies using self-efficacy focused interventions to improve self-efficacy

Author	Purpose	Study population	Intervention	SE Scale	Pre score/initial	Post score/follow-up	Results/Conclusions	LOE
Hammond (1999) <sup>120</sup>	To develop an education program using an educational-behavioral approach based on the Health Belief Model and Self-efficacy Theory; to identify whether adherence with joint protection can be increased following the program, and to identify some of the psychological factors which may influence adherence.	RA (n = 35)	The joint protection education program consisted of four weekly 2-hour sessions, plus an optional home visit within 2 weeks of the end of the program. The educational component used the Health Belief Model and Self-Efficacy Theory as a foundation. Practice with supervision, modelling on others, and verbal persuasion were used.	ASES	Median (IQR) Treatment group = 5.3 (3.4-6.2), control group = 6.45 (4.28-7.13)	Median (IQR) Treatment group = 4.6 (3.7-5.5), control group = 5.8 (4.23-7.2)	No significant changes in measures of self-efficacy occurred post-education. Those participants that changed their behavior tended to have higher self-efficacy scores (p = 0.07) than those who did not change. Education interventions may or may not aid in improving self-efficacy.	2

Table 3.4 (Continued)

Hammond (2004) <sup>124</sup>	To evaluate the long-term effects of joint protection on health status.	RA (n = 127)	The joint protection program applied educational, behavioral, motor learning and self-efficacy enhancing strategies to increase adherence.	ASES- pain	Median (IQR) Treatment group = 50 (38-64), control group = 50 (36-69)	Median (IQR) Treatment group = 54 (36-76), control group = 52 (40-69)	A within group analysis found that joint protection group had improved self-efficacy scores for pain. This approach is more effective in increasing self-efficacy and improving adherence than the control group.	2
Hughes (2004) <sup>135</sup>	To assess the impact of a low cost, multicomponent physical activity intervention.	Knee OA (n = 150)	Fit and strong intervention: 90-min sessions, 3 times/week for 8 weeks. 60 minutes of the program consist of resistance training and fitness walking, 30 minutes consist of an educational component. Utilized goals, provided feedback, and social support.	ASES, BAES	Treatment group: ASES for exercise = $7.8 \pm 2.6$ BAES = $73.5 \pm 22.9$ Control group: ASES for exercise = $6.9 \pm 3.9$ BAES = $65.5 \pm 22.6$	6 months-Treatment group: ASES for exercise = $7.9 \pm 2.5$ BAES = $59.7 \pm 24.1$ Control group: ASES for exercise = $5.9 \pm 2.8$ BAES = $50.5 \pm 19.6$	Differences were found ( $p < 0.05$ ) favoring the treatment group on the ASES at 2 and 6 months. No differences found between groups on the BAES. Preliminary findings suggest that this low cost, multiple component intervention can increase self-efficacy and adherence for exercise.	2



Table 3.4 (Continued)

Hughes (2006) <sup>136</sup>	To assess short/long term efficacy of and adherence to a multicomponent exercise intervention.	OA (n = 215)	Fit and strong intervention was offered for 90-min sessions, 3 times/week for 8 weeks. 60 mins of the program consist of resistance training and fitness walking, 30 mins consist of an education. Utilized goals, provided feedback, and social support.	ASES, BAES	Treatment group: ASES = $7.5 \pm 2.7$ BAES = $71.6 \pm 23.2$ Control group: ASES for exercise = $6.9 \pm 2.6$ BAES = $65.8 \pm 23.0$	6 months-Treatment group: ASES = $8 \pm 2.4$ BAES = $61.7 \pm 23.2$ Control group: ASES for exercise = $5.9 \pm 2.8$ BAES = $49.1 \pm 19.6$	There was a significant difference found ( $p < 0.01$ ) favoring the treatment group on the ASES at 2, 6 and 12 months. There was no differences between groups on the BAES.	2
King (2002) <sup>137</sup>	To examine effectiveness of a supervised exercise program, a self-management education program, and the combination on self-efficacy.	FM (n = 152)	4 groups: exercise only, education only, exercise and education, or control. Education program incorporated components of Social Cognitive Theory.	CPSES	CPSES: Exercise = $50.4 \pm 19.8$ , education = $52.4 \pm 20.6$ , both = $50.6 \pm 17.0$ , control = $47.9 \pm 17.8$ .	CPSES: Exercise = $55.3 \pm 18.8$ , education = $56.3 \pm 19.7$ , both = $60.3 \pm 22.0$ , control = $48.4 \pm 20.5$ .	A group x time interaction was reported with the compliance analysis for the self-efficacy ( $p = 0.003$ ). The exercise and education group increased their self-efficacy more compared to the control group.	2

Table 3.4 (Continued)

Levinger <sup>43</sup>	To examine feasibility of a 3 month internet-based intervention for enhancing recovery and self-efficacy.	ACL (n = 32)	Internet-based intervention consisting of information and communication for patients. Incorporated educational self-management and social support.	Knee Self-Efficacy scale	Control group = $2.4 \pm 3.2$ (daily activities) Intervention group = $1.5 \pm 1.5$ (daily activities)	Control group = $6.0 \pm 2.9$ (daily activities) Intervention group = $5.8 \pm 1.5$ (daily activities)	Group by time interaction on both self-efficacy subscales was significant ( $p < 0.01$ ). The internet intervention was a useful tool for reinforcing rehabilitation exercise and may improve self-efficacy.	2
Nordin <sup>121</sup>	To evaluate the effects of multimodal rehab (MMR) in combination with the web-behavior change program for activity compared to MMR in primary health care regarding self-efficacy.	Musculoskeletal pain (n = 109)	Intervention arms: MMR and web-program or MMR. MMR consisted of 2-3 times/week for 6-8 weeks and included home exercises. The web-program was used without clinician guidance and allowed the patient to choose from the content.	ASES and GSE	ASES pain MMR and web group = $45.8 \pm 21.6$ MMR only group = $49.0 \pm 20.4$ GSE MMR and web group = $2.9 \pm 0.6$ MMR only group = $2.97 \pm 0.46$	12 month follow-up ASES pain MMR and web group = $53.2 \pm 22.3$ MMR only group = $46.9 \pm 22.2$ GSE MMR and web group = $2.93 \pm 0.62$ MMR only group = $3.08 \pm 0.56$	There were no significant treatment effects over time between groups for the ASES pain ( $p = 0.04$ ) or GSE ( $p = 0.30$ ). Nor were there improvements over time for either group for ASES pain ( $p = 0.28$ ) or GSE ( $p = 0.12$ ).	2

Table 3.4 (Continued)

Palmer <sup>41</sup>	To determine the additional effects of TENS in knee OA when combined with a 6-wk group education and exercise regimen.	Knee OA (n = 224)	3 parallel arms: TENS group, sham TENS, and exercise/education group. All participants participated in a 1-hr session of 30 min education and 30 min exercise for 6 consecutive weeks.  Education program focused on enhancing abilities to self-manage their condition.	ASES	Median (Interquartile range) TENS group = 14.6 (4.0) sham TENS group = 15.0 (3.9) and exercise/education group = 14.6 (3.5)	Median (Interquartile range) TENS group = 15.8 (4.5) sham TENS group = 16.0 (4.1) and exercise/education group = 16.0 (5.5) at week 24.	Self-efficacy improved over time (p = 0.031), but no differences in trial arms exist.  The findings of this study fail to support the use of TENS as an adjunct to a group education and exercise intervention, although self-efficacy improved over time.	2
Rini <sup>140</sup>	To evaluate the potential efficacy of an 8-wk, automated, internet-based version of pain coping skills training on self-efficacy.	Knee or hip OA (n = 113)	Internet-based PainCOACH intervention consisted of 8, 35-45 min modules that provided training on behavioral or cognitive coping skills.	ASES	Control group = 6.31 and treatment group = 6.66	Control group = 6.7 and treatment group = 7.52	The treatment group reported significantly higher self-efficacy than the control (p = 0.04) and the intervention group reported self-efficacy increased (p = 0.023).	2

Table 3.4 (Continued)

Taylor <sup>141</sup>	To determine the effectiveness of a novel, theoretically based group pain management support intervention.	Chronic musculoskeletal pain (n = 652)	Experiential group was based on cognitive behavioral principles. This included cognitive behavioral approaches to manage pain, an educational DVD, with communication skills, relationship hobbies, posture and movement, and breathing, relaxation, and guided imagery.	PSEQ	Control = 30.6 ± 14.1, intervention = 31.2 ± 13.8	6 month follow-up: Control = 32.7 ± 15.0, intervention = 35.5 ± 14.0	Pain-related self-efficacy was better in the intervention group at 6 months (difference 2.3, 95% CI:0.6-4.1).  Self-efficacy was improved more in the intervention group at 6 months compared to the control group, but no sustained benefits at 12 months for pain-related self-efficacy.	2
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\*Population: FM= Fibromyalgia, OA= Osteoarthritis, RA= Rheumatoid arthritis; mod = modified version

\*Scales: ASES= Arthritis Self-efficacy Scale, BAES = Barriers Adherence Efficacy Scale, PSEQ= Pain Self-Efficacy Questionnaire, GSE= general self-efficacy scale

### *Study Characteristics*

The included studies were randomized control trials (18), longitudinal studies (2), cohort (3), cross-sectional (2), secondary analyses of randomized control trials (3), or a crossover (1). Of the 29 studies, 14 recruited from arthritic patient populations (osteoarthritis or rheumatoid), ten from a population with musculoskeletal injury or pain, and five from a population suffering from fibromyalgia. Patient ages ranged from 20-86 years and adherence to rehabilitation ranged from 0-100% in the included studies. Extracted data are presented in Table 3.3 and 3.4. Table 3.3 includes extracted data from ten studies that have used measures of self-efficacy to predict patient adherence or found relationships with adherence in musculoskeletal rehabilitation. Table 3.4 includes extracted data from ten studies that specifically targeted self-efficacy in their interventions and measured self-efficacy pre- and post-intervention. Synthesis of all self-efficacy instruments are compiled in Table 3.5.

### *Self-Efficacy Measures Included*

This investigation identified 14 scales or questionnaires that assess self-efficacy when used in conjunction with assessment of patient adherence. Many of the self-efficacy scales used in these and other studies have demonstrated sufficient internal consistency values (Cronbach's  $\alpha = 0.75-0.94$ ), but lack evidence of test-retest reliability and validity. The scales identified were primarily condition- or task-specific scales (Table 3.5), however, some do not fall into either of those categories and include the General Self-Efficacy Scale, Ewart's Scale of Self-Efficacy, and the Health Belief Model.

### *Condition-Specific Scales*

The most common scale used to assess self-efficacy within this review and one of the more psychometrically sound instruments was the Arthritis Self-Efficacy Scale. This 20-item scale has three subscales (pain, function, and coping with other symptoms) with all questions answered on a 10 (very uncertain) to 100 (very certain) Likert scale. The psychometric properties of this instrument have been well established with internal consistency values ranging from 0.75-0.90 and test-retest reliability ranging from 0.85-0.90. This scale has established construct validity with significant relationships found with health status, specifically disability ( $r = -0.68$  to  $-0.73$ ) and concurrent validity ( $r = 0.61$ ) when compared to actual performance.<sup>142</sup>

Less commonly used, the Knee Self-Efficacy Scale<sup>43,143</sup> was created for patients with an anterior cruciate ligament injury. The Knee Self-Efficacy Scale has 21-items that assess self-

efficacy and its relationship to sport activities, knee function, and daily activities. Items are answered on a 0 (Not at all certain) – 10 (Very certain) Likert scale. The scale has excellent internal consistency ( $\alpha = 0.94$ ), good test re-test reliability ( $ICC = 0.75$ ), and established content and convergent validity.<sup>143</sup> This scale is negatively correlated with the Coping Strategies Questionnaire ( $r = -0.11$  to  $-0.25$ ) and positively associated with the function dimension of the SF-36 ( $r = 0.8$ ) and the Knee Injury and Osteoarthritis Outcome Score ( $r = 0.4$  to  $0.7$ ).<sup>143</sup>

The Chronic Pain Self-Efficacy Scale and the Pain Self-Efficacy Questionnaire are assessments of a patient's self-efficacy when suffering from chronic or persistent pain.<sup>144,145</sup> The Chronic Pain Self-Efficacy Scale is a 20-22 item-scale rated on a 10 (Not at all certain) - 100 (Very certain) Likert scale, whereas the Pain Self-Efficacy Questionnaire is 10 items rated on a 0 (Not confident) – 6 (Completely confident) Likert scale. These scales have high internal consistency ( $\alpha = 0.87 - 0.92$ ), and some form of established validity.<sup>144,145</sup> The Pain Self-Efficacy Questionnaire has demonstrated test re-test reliability, whereas the Chronic Pain Self-Efficacy Scale has not. The Chronic Pain Self-Efficacy Scale has strong convergent validity with depression and hopelessness scores ( $r = -0.34$  to  $-0.62$ ).<sup>145</sup> The Pain Self-Efficacy Questionnaire has a strong, negative correlation with the Pain Beliefs Questionnaire ( $r = -0.74$ ) and positive correlations with most of the subscales on the Coping Strategies Questionnaire ( $r = 0.45$  to  $0.56$ ).<sup>144</sup>

### *Task-Specific Scales*

A number of scales specific to physical activity and exercise were identified. The Self-Efficacy for Physical Activity scale measures an individual's confidence in their ability to exercise in various situations such as when tired, in a bad mood, or when on vacation. These situations are rated on an 11-point Likert scale from "not confident at all" to "very confident."<sup>133,146</sup> The scale has excellent test re-test reliability but does not have reported validity.

Exercise self-efficacy may be assessed with either the Exercise Self-Efficacy or the Self-Efficacy for Exercise scale. The Exercise Self-Efficacy scale inquires about one's ability to continue to exercise in the future three times per week at moderate intensity for 40+ minutes. This 11-item scale has responses that are rated from 0% (Not at all confident) – 100% (Highly confident). A secondary search for psychometric properties yielded no results. The Self-Efficacy for Exercise scale is 9-items inquiring about an individual's confidence to exercise for 20 minutes, three times a week, under varying circumstances. Responses are rated on a 0 (Not confident) – 10 (Very confident) point Likert scale. The Self-Efficacy for Exercise scale has

excellent internal consistency ( $\alpha = 0.92$ ),<sup>147</sup> but lacks test re-test reliability. Established construct and criterion validity revealed a relationship between high self-efficacy and better physical and mental status.<sup>147</sup>

Another exercise specific self-efficacy scale included the Aquatic Exercise Self-Efficacy scale. This scale was modified from previously developed exercise self-efficacy scales specifically for aquatic exercise directed at fibromyalgia patients. The 8-items in the Aquatic Exercise Self-Efficacy scale address the patient's confidence in sustaining aquatic exercise for at least 6 months under various conditions.<sup>130</sup> This scale was used in only one of the included studies and was modified specifically for that study. The internal consistency of the scale was deemed excellent ( $\alpha = 0.94$ ) with only content validity confirmed by nursing professors who were experts in aquatic exercise.<sup>130</sup>

Studies by Hughes et. al<sup>135,136</sup> used two scales created by McAuley et. al<sup>148</sup> to assess self-efficacy for exercise adherence: the Time Exercise Adherence Scale and the Barriers Adherence Efficacy Scale. The Barriers Adherence Efficacy Scale measures self-efficacy for adherence to exercise in the face of barriers and contains 13-items. Hughes et al.<sup>135</sup> found this scale's internal consistency to be excellent ( $\alpha = 0.93$ ). The Time Exercise Adherence Scale is a 6-item scale that inquires of one's self-efficacy to continue exercising regularly over the next six months. The internal consistency was excellent ( $\alpha = 0.98$ ). Validity measures had not been determined for either scale.

Less specific to general exercise and more specific to rehabilitation exercise is the Sports Injury Rehabilitation Beliefs Scale. The Sports Injury Rehabilitation Beliefs Scale is a 19-item assessment of a patient's consideration of rehabilitation following a sports related injury. Only four of the 19 items are related to self-efficacy, other items include injury severity, susceptibility, treatment efficacy, and rehabilitation values. Patients rate the items from 1 (Very strongly disagree) – 7 (Very strongly agree). Internal consistency of the self-efficacy items have alpha values between 0.79 – 0.91,<sup>29</sup> no other psychometric properties were found with a secondary search.

#### *Self-Efficacy for HEP and Relationship with Adherence*

No scale was identified within this review to specifically assess self-efficacy for HEPs. Although no tool was identified, Cheung et al.<sup>127</sup> used the Self-Efficacy for Exercise scale to correlate class attendance and home practice with self-efficacy for exercise. They found that the scale predicted class attendance well ( $r = 0.34$ ,  $p = 0.03$ ), but not home exercise practice ( $r =$

0.14).<sup>127</sup> Table 3.3 displays the results for all studies that used self-efficacy to predict adherence to rehabilitation or found relationships with adherence. Due to inconsistencies in reporting of information, not all of these scales may be compared. Self-efficacy was found to be moderately correlated ( $r = 0.3-0.39$ ) with adherence when using the Exercise Self-Efficacy scale, Health Belief Model, Self-Efficacy for Exercise Scale, and the Sports Injury Rehabilitation Beliefs Scale.<sup>32,78,127,138</sup> The strongest correlation ( $r = 0.39$ ) was found using the Sports Injury Rehabilitation Beliefs Scale using the four self-efficacy items. Researchers using a version of the Arthritis Self-Efficacy Scale and the Self-Efficacy for Exercise Scale report the odds ratios for those with high and low self-efficacy. Those with higher exercise self-efficacy on the Arthritis Self-Efficacy Scale are approximately more likely to engage in exercise at baseline, 6, 12 and 18 months.<sup>25</sup> The scores from the Self-Efficacy for Exercise Scale indicated that those who scored 10 points higher on their initial self-efficacy assessment increased the odds ( $OR = 1.05$ , 95%  $CI = 1.02-1.09$ ) of actually completing and adhering to the study by 10.5%.<sup>77</sup>

### *Self-Efficacy and Interventions*

To address our secondary aim, Table 3.4 was created. Table 3.4 displays study characteristics and provides the self-efficacy scales used with self-efficacy focused interventions. When the goal is to improve self-efficacy with an intervention, it is important to assess self-efficacy pre- and post- intervention to document change. The scales currently being used to track changes in self-efficacy over time include the Arthritis Self-Efficacy Scale, Chronic Pain Self-Efficacy Scale, Ewart's Scale of Self-Efficacy, Exercise Adherence Self-Efficacy, General Self-Efficacy Scale, Knee Self-Efficacy Scale, Pain Self-Efficacy Scale, and the Self-Efficacy for Physical Activity scale. Interventions found to target and improve self-efficacy include educational sessions with foundations from Social Cognitive Theory, cognitive behavioral therapy, and interventions that incorporate goal setting, systematic feedback, and provided social support.<sup>41,43,135,140</sup>

### **Discussion**

This systematic review compiled patient self-report scales assessing self-efficacy currently in use along with evaluation of adherence to rehabilitation exercise to address four specific aims. To answer aims 1 and 2, there were 14 scales extracted that range from general self-efficacy to task, symptom, or even condition specific self-efficacy (Table 3.5), but to date, there has yet to be an assessment tool developed for self-efficacy for HEPs. This lack of assessment tool poses an issue. Not only is self-efficacy task-specific, but also no scale at this time has found a strong relationship with HEP adherence. To address aim 3, the majority of the



identified scales have good to excellent internal consistency values and some form of validity, but few have demonstrated test re-test reliability. To address aim 4, the scales that have been used to predict or associate self-efficacy with adherence include the Arthritis Self-Efficacy Scale, Self-Efficacy for Physical Activity, Self-Efficacy for Exercise scale, Sports Injury Rehabilitation Beliefs Scale, and the Exercise Self-Efficacy scale. These self-efficacy scales have, at best, a moderate relationship with adherence. Development of a new self-efficacy scale specifically addressing HEPs may aid in strengthening this relationship.

Many of the self-efficacy scales identified in this systematic review are condition or diagnosis specific. The most commonly used, the Arthritis Self-Efficacy scale, was developed to measure patients' perceived self-efficacy to cope with the results of their arthritis.<sup>142</sup> Although the scale is comprehensive and has established psychometric properties, it does not address self-efficacy for HEPs or even general exercise. This is problematic if the goal is to determine a patient self-efficacy for HEPs. Scales that lack task specificity may be problematic. Condition-specific measures of self-efficacy are based on the diagnosis and a variety of activities of daily living, not always exercise. Also important to note is that condition-specific scales capture beliefs about a disease or injury and are not geared towards adherence.

Table 3.5 Self-efficacy scales

Self-Efficacy Measure	Author	Study Population	Response Scale	# of Items	Score	Internal Consistency (Cronbach's $\alpha$ )	Test Re-test Reliability	Validity
Ewart's Scale of Self-efficacy	Baker <sup>126</sup>	OA	0 (Definitely cannot do) – 100 (Definitely can do), increments of 10	5 - 7	Mean	NR	NR	NR
ASES <sup>142</sup>	Baxter, <sup>133</sup> Bearne, <sup>123</sup> Gowans, <sup>149</sup> Hammond (1999, 2004, 2004), <sup>120,124,129</sup> Hughes (2004, 2006), <sup>135,136</sup> King (2008), <sup>131</sup> Nordin, <sup>121</sup> Palmer, <sup>41</sup> Skou, <sup>139</sup> Williamson <sup>125</sup> Used 8-item version- Rini <sup>140</sup> Used modified versions- Oliver, <sup>25</sup> Skolasky <sup>122</sup>	RA, MSK pain, FM, OA	10 (very uncertain) - 100 (very certain)	20	Mean	0.75 - 0.9	0.85 - 0.9	Construct

Table 3.5 (Continued)

Self-Efficacy for Physical Activity <sup>146</sup>	Andersen, <sup>76</sup> Baxter, <sup>133</sup> Dalager, <sup>96</sup> Oliver <sup>25</sup>	MSK pain, FM, RA	1 (Not at all confident) – 11 (Very confident) or a 1 - 5 scale using the same anchors as above	5 - 7	NR	0.82	0.9	NR
Health Belief Model	Chen <sup>78</sup>	Upper extremity impairment	1 (strongly disagree) – 5 (strongly agree)	19-total, only 2 specific to self-efficacy	Sum	NR	NR	NR
SEE Scale <sup>147</sup>	Cheung, <sup>127</sup> Stenstrom <sup>77</sup>	Inflammatory rheumatic disease, OA	10 – 100 or 0 (Not confident) – 10 (Very confident)	9	Sum	0.92	NR	Construct
SIRBS <sup>29</sup>	Grindley <sup>32</sup>	MSK injury	1 (Very strongly disagree) – 7 (Very strongly agree)	19-total, only 4 specific to self-efficacy	Mean	0.79 - .91	NR	NR
BAES <sup>148</sup>	Hughes (2004, 2006) <sup>135,136</sup>	OA	0 - 100	13	Mean	0.93 – .94	NR	NR

Table 3.5 (Continued)

Time Exercise Adherence Scale <sup>148</sup>	Hughes (2004, 2006) <sup>135,136</sup>	OA	0 - 100	6	Mean	0.95 - .98	NR	NR
Aquatic exercise self-efficacy scale	Kang <sup>130</sup>	Arthritis	10 (No confidence) – 100 (Very confident)	8	Sum	0.94	NR	Content
CPSES <sup>145</sup>	King (2002), <sup>137</sup> Schachter <sup>132</sup>	FM	10 (Very uncertain) – 100 (Very certain)	20 - 22	Sum	0.87 – .9	NR	Construct
Knee self-efficacy scale <sup>143</sup>	Levinger <sup>43</sup>	ACL reconstruction	0 (Not at all certain) – 10 (Very certain)	21	Mean	0.78 - .94	0.75	Content, construct
ESEQ	Mannion <sup>138</sup>	Chronic low back pain	0 (Not certain at all) – 66 (Absolutely certain)	11	NR	NR	NR	NR
GSE scale <sup>150</sup>	Nordin <sup>121</sup>	MSK pain	1 (Not at all true) – 4 (Exactly true)	10	Sum	0.76 – .9	NR	Construct
PSEQ <sup>144</sup>	Taylor <sup>134</sup>	MSK pain	0 (Not confident) – 6 (Completely confident)	10	Sum	0.92	0.73	Construct

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Table 3.5 (Continued)

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\*Population: ACL= Anterior cruciate ligament, FM = Fibromyalgia, MSK = musculoskeletal, OA = Osteoarthritis, RA = Rheumatoid arthritis

\*NR = not reported

\*Scales: ASES= Arthritis Self-efficacy Scale, BAES = Barriers Adherence Efficacy Scale, CPSES = Chronic Pain Self-Efficacy Scale, ESEQ = Exercise Self-Efficacy Questionnaire, PSEQ= Pain Self-Efficacy Questionnaire, SEE = Self-Efficacy for Exercise, SIRBS = Sports Injury Rehabilitation Beliefs Scale, GSE= general self-efficacy scale

Additional information on scale validity can be found within the text.

Self-efficacy is highly task-oriented: therefore, it is important to have scales developed for specific tasks. This systematic review included a number of task specific scales focused on exercise including the Aquatic Exercise Self-Efficacy, Self-Efficacy for Physical Activity, Exercise Self-Efficacy, and the Self-Efficacy for Exercise scale. Items in these scales assessed beliefs individuals hold with respect to general physical activity and exercise, and any lacking beliefs about rehabilitation exercise. Despite their value, none of the above scales are specific enough to address self-efficacy for HEPs following a musculoskeletal injury.

Because clinicians use scales in research and/or clinical practice, the psychometric properties of these instruments should not be ignored. The majority of the scales provide limited data related to psychometric properties. Internal consistency values ranged from good to excellent and construct validity was most commonly evaluated. None of the included scales have criterion validity. Criterion validity, in this case, is difficult to evaluate as there are no gold standard measurements for these types of constructs. Test re-test reliability was only established for the Arthritis Self-Efficacy Scale, Self-Efficacy for Physical Activity, the Knee Self-Efficacy Scale, and Pain Self-Efficacy Scale. This psychometric property is clinically useful for clinicians administering these scales for pre- and post-testing. Without intraclass correlation coefficients, standard error of measurement, and minimal detectable change values it is difficult to know if changes in scores are meaningful beyond measurement error or valued by the patient.

When selecting a self-efficacy scale to implement it is best to choose one with both well-established reliability and validity. Unfortunately, a few of the instruments do not have reliability or validity established so must be used with caution. Research in other healthcare domains have found it common that some clinical measures have not been adequately validated.<sup>151-153</sup> A further concern is that modifying a scale for a particular population could invalidate previously documented psychometric properties. This has occurred in studies comparing an original scale with a modified version; prior psychometric property assumptions were violated.<sup>154-156</sup> Therefore, modifying scales to fit population needs is not advisable without further validation of the scale.

Self-efficacy is a relatively strong predictor of adherence to HEPs in a recent systematic review by Holden et al.<sup>12</sup> A moderate relationship between self-efficacy and adherence was also found in this systematic review; however, the scales discussed here were not specific to self-efficacy for HEPs. Consequently, the need to have a scale designed specifically to assess self-efficacy for HEPs is apparent. In Bandura's chapter on constructing self-efficacy scales, he notes the "one measure fits all" approach has limited explanatory and predictive value with less relevance to the domain in question.<sup>90</sup> When exercise rehabilitation adherence self-efficacy is in

question, scales such as the General Self-Efficacy Scale, as Bandura suggests, would have little relevance. Picha and Howell<sup>2</sup> have proposed that to improve adherence to HEPs using a self-efficacy framework as a scale needs to be developed specific to that task is required. A scale geared towards self-efficacy for HEPs should correspond to and be specific to the appropriate domain, two qualities of a good self-efficacy measure.<sup>90</sup> Providing clinicians with a scale that addresses self-efficacy for HEPs is the necessary first step to improve self-efficacy from the start of treatment.

Strategies to improve self-efficacy for rehabilitation exercise have been found to be successful.<sup>41,43,134,140</sup> Although this systematic review did not specifically focus on intervention studies, an important future step is to determine which interventions have been effective in improving self-efficacy. Successful interventions identified in this study have reported ways to incorporate the sources of self-efficacy to increase patient beliefs in their capabilities. Future research should examine which strategies are most effective at improving outcomes for patients with musculoskeletal injury. The scales used to track these improvements in self-efficacy were important to identify so they can be used in future work with the knowledge of their ability to detect change. The measures included here have the ability to track changes over time, but the administrator needs to understand which scales are specific to the task and situation of interest.

#### *Strengths and limitations of this review*

This systematic review is not without limitations or the potential for bias. First, the risk of publication bias is apparent as we only reviewed articles published in select databases.<sup>157</sup> Second, the studies included were written in English allowing for the potential of language bias. Also, the possibility that studies in different languages might have yield additional scales. Third, this review only included studies that evaluated self-efficacy in relationship to adherence to rehabilitation.

#### *Strengths and limitations of reviewed studies*

The studies reviewed were rated a level of evidence of two or three and quality ranged from a 6 to a 10 on the Modified Downs and Black assessment.<sup>118</sup> Although most of the studies were rated as being of high quality, limitations existed. Researchers that modified an existing self-efficacy questionnaire, such as Oliver et al.<sup>25</sup> and Skolasky et al.,<sup>122</sup> to apply to a specific population of interest altered the integrity of the scale.<sup>25,76,96,122,130</sup> The reliability and validity of these scales may have been assessed in their original form, but if modifications are made to the scale, the psychometric properties of that instrument may not hold true. The last question on the

Modified Downs and Black was commonly missed due to lack of reliability and validity reporting of outcome measures, especially for the self-efficacy scales. When this information was not reported, an additional informal search to obtain it was conducted.

## Conclusion

This systematic review sought to identify existing self-report patient scales used to monitor adherence to rehabilitation in patient populations with musculoskeletal injuries. A number of self-efficacy scales aimed at this patient population were found to be reliable and valid tools for assessing self-efficacy, predicting adherence to rehabilitation, and assessing improvement in self-efficacy over time. However, a tool to assess self-efficacy for HEPs does not yet exist. As HEPs are an essential component to rehabilitation coupled with the evidence suggesting that self-efficacy may predict adherence, a reliable and valid scale designed to specifically assess self-efficacy for HEPs is needed.



## **Chapter 4: Physical Therapists' Assessment of Patient Self-Efficacy for Home Exercise Programs**

### **Introduction**

Rehabilitation is often required following a musculoskeletal injury or surgery to return patients back to normal function. Although the benefits of rehabilitation are known, patients are frequently non-adherent to rehabilitation programs. Research has indicated a 50-70% non-adherence rate for patients with scheduled rehabilitation appointments or in-home exercise programs.<sup>10,11,12</sup> Home exercise programs (HEPs) contribute substantially to patient outcomes<sup>66</sup> and are a necessary part of rehabilitation. Barriers to patient rehabilitation adherence have included several patient factors such as; anxiety, depression, forgetfulness, lack of social support, low levels of activity at baseline, pain with exercise, and low self-efficacy.<sup>9,11</sup>

Within the healthcare and exercise realm, low self-efficacy is a barrier to adherence that clinicians can positively influence.<sup>9,33</sup> Self-efficacy refers to beliefs in one's capabilities to perform given tasks. Researchers have used a variety of measures to evaluate self-efficacy beliefs in general, for exercise, and pain.<sup>39,89,99</sup> Many solutions or strategies have been studied in an attempt to improve self-efficacy and adherence to rehabilitation.<sup>33,39,42</sup> With interventions to improve self-efficacy, patients hypothetically should become more adherent to rehabilitation; unfortunately, the literature has not indicated these improvements. Low self-efficacy to rehabilitation exercise adherence needs to be addressed to increase adherence, improve patient outcomes, and reduce the cost associated with musculoskeletal injuries.

In order for clinicians to improve self-efficacy and adherence, assessments of self-efficacy must be completed. Currently unknown is if clinicians are assessing self-efficacy as a routine of standard clinical practice, especially for HEPs. The purpose of this study is to survey clinicians to determine their approach to assess patient barriers when creating a HEP, specifically self-efficacy. There are three specific aims of this study 1) to determine importance of patients' self-efficacy to physical therapists when addressing patient barriers to rehabilitation exercise adherence, 2) to determine how physical therapists are assessing and utilizing patients' self-efficacy for HEP adherence, and 3) to determine the barriers facing physical therapists in assessing patients' self-efficacy for HEP adherence. We hypothesize that physical therapists will not recognize self-efficacy as one of the top three barriers to patient adherence to HEPs. We hypothesize physical therapists will report using observation to assess self-efficacy at least 50% of the time. Lastly, we hypothesize that physical therapists will report a lack of time as the most common barrier for not assessing self-efficacy for HEPs.

## **Methods**

### *Study and Survey Design*

This study involved a cross-sectional survey approved by the University's institutional review board. The survey was created by the primary author and reviewed by the research team. The first step in the development of this survey was to determine relevant items in question. The following steps were item generation, item reduction, and pre-testing. Over 30 items were first generated to address the above aims. The research group reduced items down to approximately 20 specific items, eliminating similar or duplicate items unrelated to the presented aims. Pre-testing was conducted first with the University's Survey Research Center to ensure the survey was developed and functioning as intended. The second cohort of pre-testing was conducted using practicing clinicians. Physical therapists, athletic trainers, and a self-efficacy expert ensured content validity testing during this phase. Because this survey inquires about clinicians' practice habits and perspectives, reliability analysis of internal consistency is difficult and not often done.<sup>158,159</sup> However, the authors did try to examine kappa values for applicable, dichotomous variables of four participants, finding values ranged from moderate to perfect agreement (0.5 - 1.0). Additionally, for rank ordered questions, answers were graphed in scatter plots to determine their linearity (Appendix 3) finding that most participants answered the same or close to between days. The final version of the survey contains a minimum of 10 questions with branching logic embedded to populate 2-3 additional questions based on previous answers (Appendix 4) and required 5-7 minutes to complete. Not all questions included in the survey were used to directly answer the aims of this study. The number of questions varies based on previous responses, as some questions populate questions or require an explanation.

### *Participants*

This study invited 17,730 practicing physical therapists. Of those, 462 (age  $41 \pm 12$  years, work experience  $15 \pm 12$  years, work experience range = 0.5-53 years) surveys were submitted, demonstrating a 2.6% response rate. Additional participant demographics are presented in Table 4.1. All participants were volunteers recruited through the American Physical Therapy Association's Orthopedic Section via a one-time email sent by the association. Participants were included if they were willing and able to complete the online survey. Participants were excluded if they checked "no" to the consent question.

### *Procedures*

Potential participants received an email describing the study that included a link to the survey. The survey was administered in Qualtrics (an electronic data capture system hosted at the University of Kentucky). Qualtrics is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to statistical packages, and 4) procedures for importing data from external sources.

### **Data Analysis**

To address aim 1, three questions were asked. The first question was a five point Likert scale ranging from (0 = not important to 4 extremely important) asking the participant to rate “Relative to other barriers, how much of an influence or importance do you feel a patient’s self-efficacy or lack of confidence has on their adherence to exercise?” The data were reported as a frequency, with the expectation that at least 50% of the participants identify self-efficacy as either very important “3” or extremely important “4.” The next two questions focus on clinician observations and clinician perspective. Participants were given a matrix of eight barriers to rank order from (1 most negative to 8 least negative impact) in response to the question: “Clinically, *how often do you observe* the following patient reasons or barriers to not completing their prescribed exercise? 1 (most often/common) to 8 (least often/common).” The eight barriers were derived from the literature.<sup>9,10</sup> The third question asked, “From your clinical perspective, rank the reasons or barriers *you feel* as most negatively influential to a patient's adherence.” The lower score for both questions represented the greatest importance from the participant’s perspective. A Friedman test was used to determine if differences in ranks exist between the eight barriers. A Wilcoxon sign rank test was then used to determine where differences existed between barriers and to determine the order of most common barriers perceived and observed by physical therapists. Seven pairwise comparisons were performed therefore the p-value was adjusted to 0.007.

To address aim 2, the researchers asked two questions, one focusing on methods of assessment (Question 4) and another how the information was used to individualize treatment (Question 5). Question four was closed ended and reported as frequency counts. Four responses of assessment (Verbal discussion, Observation, Patient-reported outcomes, and Other) were provided with the ability to choose multiple options. Question five was open ended and data were compiled together systematically to understand how clinicians are utilizing patient’s self-efficacy to individualize HEPs. The first step in this process was to extract responses that reflected the

four sources of self-efficacy, mastery experience, verbal or social persuasion, vicarious experience, and physiological or emotional state. Derived from Bandura's four sources of self-efficacy, these sources are suggested to alter individual's beliefs about their capabilities. Mastery experience refers to one's past successes and failures. Key phrases such as "build confidence," "successful completion of exercises," "patient properly demonstrates exercise," "goal setting," "break down tasks," and responses that would provide a patient with a mastery experience were placed in to the mastery experience category. Bandura suggests that personal successes, in this case, mastery of rehabilitation exercise helps shape one's beliefs in their abilities.<sup>23</sup> Verbal or social persuasion involves encouragement or support from others.<sup>23</sup> Key phrases such as "discussion with the patient," "provide encouragement or positive feedback," "provide social support," and "use of cueing techniques," were placed within the verbal/social persuasion category. Vicarious experiences refer to an individual's observation of others success or failures.<sup>23</sup> Key phases placed into the vicarious experience category included "I demonstrate exercises," "show patients how to successfully complete an exercise," or "use of models." Lastly, physiological or emotional states are influenced by the body's reaction to tasks or situations. Bandura suggests reducing stress, negative emotions, and misinterpretations of physical states will alter one's self-efficacy beliefs,<sup>23</sup> therefore, key phases such as "patient education related to symptoms/pain" and "reduce pain" were placed into the physiological or emotional states category. All responses that did not fit into one of these sources were further divided into common themes.

To address aim 3, the researchers asked one question focusing on why self-efficacy assessment is not part of current practice. Participants only received this question through branching logic if they responded "No" to the previous question "do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?" Multiple barriers to assessment of self-efficacy were provided within a multiple choice question, including not knowing how to assess, assessment would not change my course of treatment, not sure what to do with the information after I assess, I do not know what self-efficacy is, takes too much time, or other. Participants were able to select multiple options. Frequency counts and percentages were derived. If the "Other" option was selected, an open text box allowed for additional responses and common themes were extracted.

Statistical analyses were performed in SPSS version 24.0 (IBM SPSS, Armonk, NY, USA).

Table 4.1 Participant characteristics (n = 462)

<b>Demographics</b>		<b>Summary</b>
Sex	Female	232
	Male	228
	Not reported	2
Level of education completed		
	Doctorate	340
	Masters	66
	Bachelors	35
	Ph.D.	20
	Not reported	1
Region of practice		
	Midwest	118
	West	111
	Northeast	98
	Southeast	94
	Southwest	33
	Not Reported	8
Setting of practice		
	Outpatient/private practice	393
	Hospital	79
	Education/research	20
	Acute care	17
	Home health	14
	Professional sports	13
	Government	12
	Subacute care	11
	Collegiate	11
	Secondary school	8
	Extended care	7
	Industrial	5

## Results

To answer aim 1, 58% of the physical therapists in this study reported self-efficacy to be very (151/454) to extremely important (114/454, Figure 4.1). Only 2% reported self-efficacy as not at all important (9/454) and eight participants did not provide a response to this question. When asked about how often patient reasons or barriers to not completing their prescribed exercise are observed by the physical therapists, a Friedman test was used. This analysis determined that physical therapists rank observed barriers differently ( $X^2 = 892.06$ ,  $DF = 7$ ,  $p < 0.001$ , Table 4.2), a Wilcoxon Signed Ranks test found the ratings to be significantly different ( $p < 0.007$ ) between all of the barriers. Physical therapists ranked lack of time as the number one observed patient barrier to adherence followed by forgetting and having low levels of activity at baseline. Observation of low self-efficacy was ranked fifth out of the eight barriers provided. Observation of low self-efficacy was not found to be significantly different than anxiety/depression ( $p > 0.007$ ). Additionally, when asked “from your clinical perspective, rank the reasons or barriers *you feel* as most negatively influential to a patient's adherence,” a Friedman test determined that physical therapists rank most influential barriers differently ( $X^2 = 252.44$ ,  $DF = 7$ ,  $p < 0.001$ , Table 4.3), a Wilcoxon Signed Ranks test found the ratings to be significantly different ( $p < 0.007$ ) between some of the barriers. Physical therapists ranked the presence of anxiety or depression as the most influential barrier to adherence ( $p > 0.007$ ). Self-efficacy was again ranked fifth but not significantly different ( $p = 0.87$ ) than low levels of activity at baseline, feelings of helplessness, and increased pain during exercises.

Figure 4.1 Physical therapists perceived importance of self-efficacy

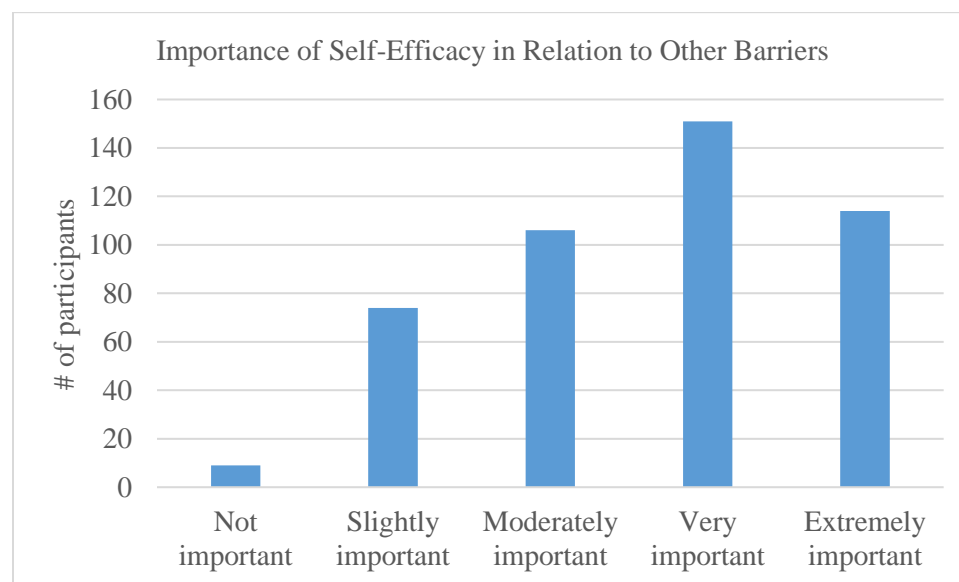


Table 4.2 Friedman test results of what physical therapists observe to be barriers to patient exercise adherence

<b>Barriers</b>	<b>N</b>	<b>Mean ranks</b>	<b>SD</b>	<b>Group differences</b>
Lack of time	460	2.51	2.15	All
Forgetting	460	3.32	2.04	All
Low levels of activity at baseline	460	3.55	2.01	All
Pain with exercise	460	4.45	2.01	All
Low self-efficacy <sup>a</sup>	460	4.97	1.94	All, except b
Anxiety/depression <sup>b</sup>	460	5.32	1.94	All, except a & c
Helplessness <sup>c</sup>	460	5.57	1.75	All, except b
Lack of social support	460	6.33	1.71	All

\*A Wilcoxon Signed Rate test detected between which groups differences exist, this is indicated in the group differences column. Three barriers were assigned a letter as indicated by the superscript.

Table 4.3 Friedman test results of what physical therapists believe the most negatively influential to patient exercise adherence

<b>Barriers</b>	<b>N</b>	<b>Mean rank</b>	<b>SD</b>	<b>Group differences</b>
Anxiety/depression	458	3.54	2.12	All
Low levels of activity at baseline <sup>a</sup>	458	3.99	2.17	All, except b, c, d
Helplessness <sup>b</sup>	458	4.20	1.90	All, except a, c, d
Pain with exercise <sup>c</sup>	458	4.26	2.21	All, except a, b, d
Low self-efficacy <sup>d</sup>	458	4.30	2.10	All, except a, b, c
Forgetting <sup>e</sup>	458	5.00	2.26	All, except f
Lack of time <sup>f</sup>	458	5.02	2.71	All, except e
Lack of social support	458	5.69	2.07	All

\*A Wilcoxon Signed Rate test detected between which groups differences exist, this is indicated in the group differences column. All barriers were assigned a letter as indicated by the superscript.

Seventy-one percent (n = 329/464) of participants answered “yes” to the question “do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?” Figure 4.2 addresses aim 2 of this study. Participants were able to select multiple choices, 89 participants chose one method, 186 participants chose two methods, 51 participants chose three methods, and only two participants chose all four methods. In total, 622 responses were given by our participants as seen in Figure 4.2. Verbal discussion was selected as the most common method of self-efficacy assessment (50%), followed by observing the patient (38%), patient self-report questionnaires (10%), and other methods (2%). Verbal discussion and patient observation were selected together 170 times accounting for 91% of those who selected two responses. Although 10 participants reported use of another method, the open-ended responses related back to either discussion with the patient or observing them complete the prescribed exercise. To determine how physical therapists are utilizing patient’s self-efficacy to individualize care, an open text format was used. Of the 329 participants that reported assessing patient self-efficacy for home exercise prior to prescribing a HEP, 310 provided an answer as to how they individualize treatment following assessment with 348 themes extracted. Table 4.4 displays frequency counts based on common themes. All four sources of self-efficacy were identified within the participant responses with mastery experience (86/348, 25%) as the most common source, followed by verbal persuasion (55/348, 16%), vicarious experience (15/348, 4%), and physiological state (11/348, 3%). Fifty-two percent of themes extracted could not be directly related back to any source of self-efficacy. Themes that were extracted from these responses included individualization of exercise programs based on patient preference, were specific to modifying sets, repetitions, and type of exercise, or focused on non-specific patient education, or simply stated observation, or based on patient resources, or fell into an “other” category. The “other” category primarily consisted of statements that were related to other findings that would alter treatment not methods of individualization, such as “Based on patient’s attitude about recovery” or “Based on their ability and allotted time.”



Figure 4.2 Methods of self-efficacy assessment used by physical therapists

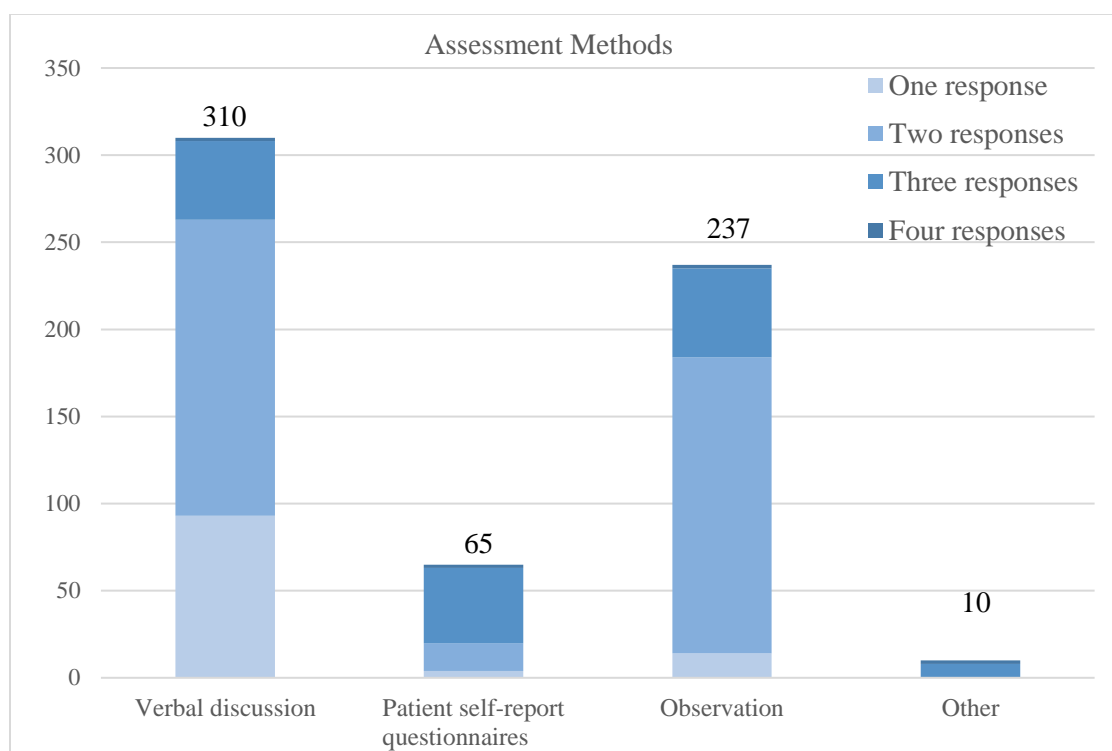


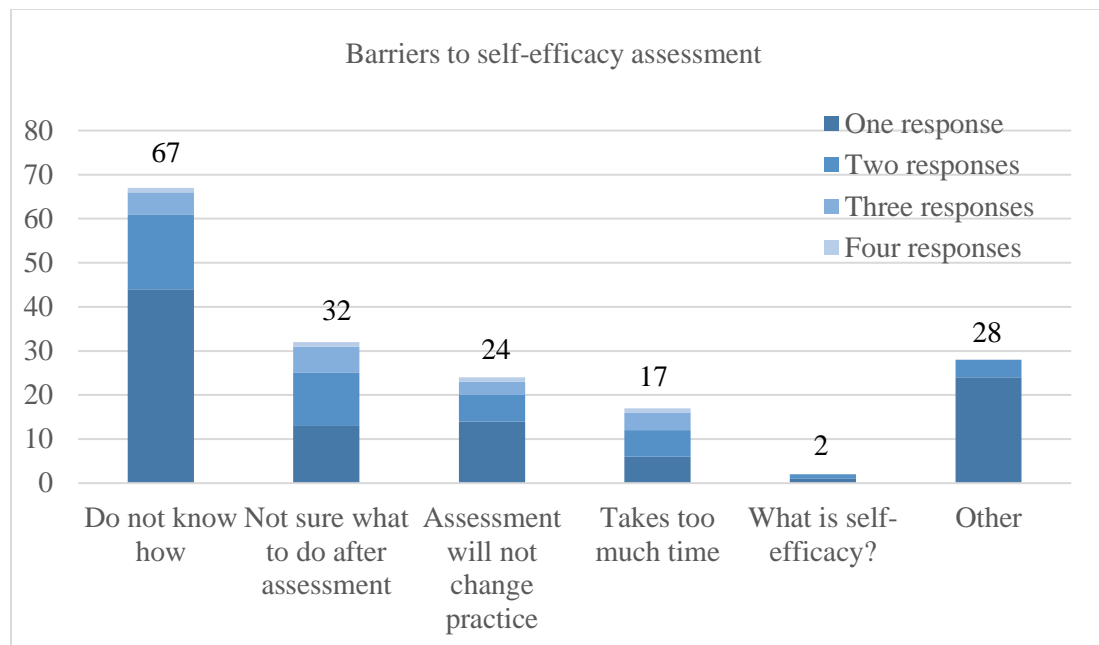
Table 4.4 Themes extracted on how physical therapists individualize HEP based on self-efficacy assessment

Theme	Frequency (Out of 348 responses)	Example of participant response
Mastery experience	86	<p>“Try to make home exercises that I have observed them successfully perform within the therapy session.”</p> <p>“Select exercises they can perform confident and successfully over time during visits; begin with 1 simple exercise to begin.”</p>
Verbal/social persuasion	55	<p>“Provide encouragement.”</p> <p>“Reinstruct as needed.”</p> <p>“Bring a family member in to help.”</p> <p>“...will follow up 24 hours later by email/phone.”</p>
Vicarious experience	15	<p>“I demonstrate a successful completion.”</p> <p>“...give written material with pictures and a web address for videos.”</p>
Physiological state	11	<p>“Prioritize based on symptom management.”</p> <p>“Teach them how specific exercises can effect them.”</p> <p>“Emphasis that they CANNOT do any harm that movement is good, they are not hurting anything.”</p>
Individualize exercise	123	<p>“I may change visit frequency or modify number/type of exercises prescribed for home.”</p> <p>“Limit the number of exercises.”</p> <p>“Modify HEP in order for them to complete it on a regular basis, such as number of exercises, per day, work schedule, family demands.”</p>
Education non-specified	12	<p>“More or less patient education.”</p> <p>“Patient education based on outcome measures.”</p>
Observation non-specified	4	<p>“Observe patient problem solve.”</p>

Table 4.4 (Continued)		
Patient resources	4	“Make sure it can be completed with available or no equipment.”
Other	38	“Make sure they can set it up their HEP easily at home.” “2 week HEP trial to assess success.”

To answer aim 3, the barriers facing physical therapists in assessing patient self-efficacy, the researchers inquired about the reasons to not assess self-efficacy for HEPs. Participants were able to select multiple choices, 106 participants chose one method, 21 participants chose two methods, six participants chose three methods, and only one participant chose all four methods. In total, 170 responses were selected by our participants. Of those physical therapists 29% that do not assess self-efficacy, 40% (n = 68/170) claim to not know how to assess self-efficacy, 19% (n = 32/170) are not sure what to do with the information once self-efficacy is assessed, 16% (n = 28/170) claim there are other barriers to assessment, 15% (n = 25/170) claim that assessing self-efficacy will not change their practice, another 9% (n = 15/170) claim assessing self-efficacy takes too much time, and the last 1% (n = 2/170) do not know what self-efficacy is. Twenty-one percent of participants reported barriers to assessing self-efficacy for HEPs reported more than one barrier (n = 28/134). Of those that claim there are other barriers, the most common theme to emerged was assessment at another time, followed by the belief that self-efficacy is not important enough or the fact that they do not prescribe HEPs.

Figure 4.3 Physical therapist's barriers to self-efficacy assessment



## Discussion

This study sought to determine physical therapists' assessment and utilization of self-efficacy in musculoskeletal rehabilitation. Fifty-eight percent of physical therapists in this cohort find self-efficacy to be very to extremely important. Although self-efficacy has been identified as an important construct influencing patient behavior and adherence to treatment, other barriers seem to be more prevalent and influential to this cohort of physical therapists. However, 71% of the physical therapists surveyed report assessing self-efficacy for HEPs prior to prescribing programs mainly with verbal discussion or observation of the patient. Twenty-nine percent of the participants do not assess self-efficacy primarily because they do not know how to assess this construct. This is a concern when seeking to improve patient adherence to HEPs using self-efficacy.

Self-efficacy is a moderate predictor of patient adherence and influential in patient behavior throughout the rehabilitation process.<sup>25,32,95,160</sup> Clinical implications to such research suggest that clinicians should focus on patient self-efficacy to improve adherence and outcomes.<sup>9,33,95</sup> This study confirms practicing physical therapists believe self-efficacy is an important concept in musculoskeletal rehabilitation. Physical therapists included in this study rated self-efficacy very to extremely important in comparison to other patient barriers. These findings are in agreement with a qualitative study including five physical therapists as these participants also felt self-efficacy does have an effect on patient adherence to treatment.<sup>161</sup>

Although self-efficacy was found important, anxiety and depression were ranked as most negatively influential and no differences were found in second rank between low self-efficacy, pain while exercising, helplessness, and low levels of activity at baseline. Without additional training, physical therapist may not be able to treat anxiety or depression and will need to refer the patient; however, they do have the ability to influence self-efficacy. Understanding what barriers the clinicians can successfully address is important when trying to improve patient adherence to HEPs.

Although self-efficacy is identified as negatively influential, when participants were requested to rank the barriers they observed most often, self-efficacy was ranked fifth and lack of time was most prevalent barrier. Patients deemed to be non-compliant have previously reported they either lacked time to exercise or the exercises did not fit into their daily schedules.<sup>10</sup> This indicates the need for physical therapist to inquire about time constraints patients may have prior to prescription of a HEP. A study by Medina-Mirapeix et al. examined adherence to HEPs with varying frequency and durations to identify if rates of adherence were different among patients with neck or back pain.<sup>74</sup> They found that exercises prescribed should be limited to three exercises or less as patients more exercises were at lower odds of being adherent to their HEP (OR = 0.2, CI = 0.1-0.9,  $p < 0.05$ ).<sup>74</sup> Further, research examining adherence to home exercise programs consisting of two, five, or eight exercises in 15 older adults.<sup>75</sup> These researchers found that when given home exercises, older adults were more compliant when given two verses eight exercises ( $p = 0.046$ ).<sup>75</sup> Consideration of a patient's time to perform a HEP appears to be valuable information to clinicians aiming to improve adherence to HEPs. Clinicians should aim to keep HEPs to 2-3 key exercises in order to facilitate adherence.

Our hypothesis that patient observation would be the most common assessment method was rejected. Verbal discussion with the patient was most commonly reported and often in combination with patient observation. Assessment of self-efficacy has been conducted with the use of scales and questionnaires within the literature (Chapter 3). A recent systematic review (Chapter 3) has compiled methods of self-efficacy assessment to find a variety of reliable and valid scales currently being used within musculoskeletal rehabilitation. This review did not find verbal discussion or observation of the patient to be reliable or valid methods of assessment, which may be problematic for our cohort. If clinicians are not using assessment methods with sound psychometric properties, confidence in the quality results may be limited. Verbal discussion and observation of self-efficacy as assessment methods are broad categories and do not provide detail on what was actually discussed with the patient or observed in clinic. These

two assessment responses limit the ability to interpret the appropriateness of the self-efficacy assessment. Only 10% of physical therapists report utilization of patient-reported scales or questionnaires. As patient-reported outcome measures are increasingly used in clinical practice as a self-report of function,<sup>162</sup> it is surprising that barriers to adherence would not be addressed using the same methodology. The use of unreliable or non-validated measures could lead to inaccurate findings or inability to effectively track progress.

Successful interventions to improve self-efficacy have been identified,<sup>33,39,99,134</sup> but it would seem as though clinicians are not utilizing the evidence or lack the knowledge of such interventions. Of the 348 themes extracted, 52% of responses provided did not actually address self-efficacy directly or even indirectly. This is worrisome and may indicate clinicians may not know how to effectively improve self-efficacy for HEPs. Many of the responses that fell into the “other” theme were well removed from the construct of self-efficacy and primarily stated that based on other barriers they individualized treatment. This may have been an issue with lack of understanding of the purposed question. Incorporating the sources of self-efficacy into rehabilitation would be important for those wanting to improve this construct, as previous studies have found promising results.<sup>33,39,99,134</sup> For example, working with the patient to set goals, providing positive feedback, or including family or friends for additional social support can be effective strategies to improve self-efficacy.<sup>33,39,97,155</sup>

Twenty-nine percent of physical therapists report they do not assess self-efficacy for HEPs. A secondary analysis of these individuals did not detect differences in age, sex, or years of experience when compared to those who do assess self-efficacy for HEPs. Of those 135 physical therapists, 40% do not know how to assess self-efficacy for HEPs and 24% do not know what to do with the information once assessed. It could be speculated that their educational programs did not cover this material sufficiently or perhaps not knowing how to assess self-efficacy for HEPs is due to the lack of instrument to assess (Chapter 3). The previously mentioned systematic review (Chapter 3) was unable to find a self-efficacy scale task-specific to HEPs and when a general exercise scale was used to evaluate self-efficacy for home exercise, no relationship was found.<sup>127</sup> Because self-efficacy is task and situation specific, scales need to reflect the tasks of interest. Future research should work to develop a proper tool to assess self-efficacy for HEPs. One study examining barriers to use of patient-reported outcomes measures indicated the most common barrier to assessment is time for patients to complete and time for clinicians to analyze or score.<sup>163</sup> In this study, time was only indicated as a barrier for 11% of physical therapists. As most of these participants perceive a patient’s self-efficacy as important, not knowing how to

assess self-efficacy for HEPs seems to be the primary issues. Another reason clinicians have previously reported not using patient-reported outcome measures is the belief that the usefulness of the measures are only for research purposes<sup>163</sup> or that the results would not change their practice.<sup>164</sup> Similarly 18% of the physical therapists responding to this survey claim that assessing self-efficacy for HEPs will not change their practice. In Stickler's<sup>161</sup> study, physical therapists report that self-efficacy does effect adherence, but believe that gaining self-efficacy is the patients' responsibility. Education programs should stress the assessment of self-efficacy and interventions to improve, especially for HEPs, as self-efficacy is a barrier found to be easily influenced by the clinician and predictor of rehabilitation adherence.

This study is not without limitations. The response rate was low and the sample of physical therapists included were primarily members of the Orthopedic Section of the American Physical Therapy Association leading to the possibility of compromising the external validity. Physical therapists in other sections or other rehabilitation clinicians may have a different perception of self-efficacy as a barrier and the use of patient self-efficacy in practice. There is also a concern of response bias as not all participants answered every question. The researchers do not know why some questions were skipped. In addition, the themes derived from the survey were based on opinion of the authors.

## **Conclusions**

Self-efficacy is an important construct influencing patient care, however, may not be the most commonly observed or negatively influential barrier from the physical therapists' perspective. The findings of this study shed light to a few key concerns with current self-efficacy assessment and utilization if seeking to improve patient adherence to HEPs. First, assessment of self-efficacy for HEPs is primarily done through verbal discussion or observation of the patient, neither of which have been found to be reliable or valid methods of assessment. Secondly, clinicians that assess self-efficacy for HEPs may not be adequately addressing patient self-efficacy within care. Only 48% of physical therapists use a source of self-efficacy or self-efficacy related intervention following assessment. Lastly, those who do not assess self-efficacy for HEPs do not know how to assess this construct, which may be due to the lack of instrumentation or education to do so. Future research should focus development of an instrument to assess self-efficacy for HEPs and work to improve implementation strategies of successful self-efficacy interventions.

## **Chapter 5: The Self-Efficacy for Home Exercise Programs Scale Development and Psychometric Properties**

### **Introduction**

Adherence to medical recommendations is essential to successful patient outcomes in rehabilitation.<sup>13,14</sup> Home exercise programs (HEPs) act as a crucial adjunct to in-clinic rehabilitation, as they defer the cost of supervised physical therapy sessions, while still providing a high level of care.<sup>13,165</sup> Hayes et al.<sup>166</sup> found that patients who had rotator cuff repair demonstrated comparable outcomes whether they were allocated to individualized physical therapy or performed an unsupervised HEP. Despite the benefits of rehabilitative exercise, adherence is low in both the clinic and home setting. In the clinic, patient adherence is approximately 50%<sup>11</sup> and rates of HEP adherence are even less.<sup>167,168</sup> With the rising cost of healthcare, prescription of HEPs may lower the financial burden associated with injury by reducing the number of clinic visits. However, if patients are non-adherent to their prescribed programs the benefits of therapy will be diminished.<sup>2</sup>

Self-efficacy is one of several barriers to rehabilitation exercise adherence and is an important construct in patient behavior.<sup>23,24,169</sup> Self-efficacy is one's belief in their ability to perform a particular task. Those with higher levels of self-efficacy have been found to be 50% more likely to engage in exercise prescription.<sup>25</sup> Not only has self-efficacy been shown to predict exercise behavior and effort,<sup>170</sup> but a construct with the ability to change. Self-efficacy is not a trait characteristic, meaning it changes based on situation or task. Behavioral intervention programs that target self-efficacy for exercise have revealed higher adherence rates (13-30%) and reduced dropout rates up to 39% when compared to controls.<sup>171,172</sup>

Despite the fact that self-efficacy is a known psychological barrier to rehabilitation exercise adherence, it is not always assessed or addressed within standard clinical practice for musculoskeletal rehabilitation through reliable and valid methods (Chapter 4). Patients with low self-efficacy may present with characteristics such as fear of failure, fear of risks or uncertainty, and low aspirations.<sup>23</sup> On the other hand, patients with high self-efficacy demonstrate self-confidence, and can quickly recover after failing or having a setback with a task.<sup>23</sup> The clinician's ability to recognize patients with low self-efficacy is important as it contributes to the problem of low adherence to HEPs. Many physical therapists report assessing self-efficacy through observation or verbal discussion with the patients, although these methods of assessment have yet to be found reliable or valid (Chapter 4).



A variety of scales have been developed to assess a patient's self-efficacy that are reliable and valid. These scales have been useful in identifying patients with low self-efficacy in cardiac rehabilitation<sup>33</sup> and in arthritic populations,<sup>142</sup> but, to the author's knowledge, no scale has been specifically directed at HEP self-efficacy in patients with musculoskeletal disorders. The Self-Efficacy for Exercise scale has been previously correlated with exercise in-clinic ( $r = 0.34$ ,  $p = 0.03$ ), but not home exercise ( $r = 0.14$ )<sup>127</sup> indicating that this scale may not be the best choice to assess self-efficacy for HEPs. Self-efficacy is situation- and task-specific, meaning there is not a general all-purpose measure.<sup>101</sup> Developing an evaluation tool that clinicians could use to screen patient self-efficacy for HEPs is necessary to further individualize patient care and overcome this barrier to rehabilitation adherence.

To date, no tool exists to evaluate self-efficacy in patients performing a prescribed HEP. The first aim of this study was to develop and evaluate a tool for assessing self-efficacy HEP, the Self-Efficacy for Home Exercise Programs Scale (SEHEPS). The researchers hypothesized that the SEHEPS would demonstrate 1) a good to excellent internal consistency ( $\alpha = 0.80 >$ ), 2) an acceptable test re-test reliability ( $ICC > 0.70$ ), and 3) a significant positive relationship with the Self-Efficacy for Exercise and Pain Self-Efficacy Questionnaire. The secondary aims of this study were 1) to determine a cutoff score that may differentiate between adherent and nonadherent patients and 2) to examine how self-efficacy relates to HEP adherence and the change in self-reported function post-rehabilitation. The researchers hypothesized that self-efficacy for HEP would positively correlate with reported adherence rates. The researchers also hypothesized that self-efficacy scores would correlate positively with self-reported functional changes.

## **Methods**

### *Scale development*

The proposed SEHEPS was modified from the Self-Efficacy for Exercise (SEE) scale.<sup>147</sup> Because self-efficacy beliefs are linked to specific realms of functioning,<sup>101</sup> a scale to assess self-efficacy for HEPs in musculoskeletal patients is essential. Item generation began by modifying the SEE from asking the patient "how confident are you right now that you could exercise three times per week for 20 minutes if..." to "how confident are you that you could perform the prescribed exercises correctly..." in relation to their prescribed HEP. To eliminate hypothetical thinking and acknowledge presence of potential barriers, the wording of "if" was changed to "when." The 9-items in the SEE scale were revised specifically to address questions related to HEPs and added three additional questions. These new questions were "1) How confident are you

that you could perform the prescribed exercises correctly as often as prescribed by your clinician, 2) How confident are you that you could perform exercises correctly when you are given written exercise instruction, and 3) How confident are you that you could perform exercises correctly when you do not have supervision or clinician feedback.” Internal focus groups consisting of athletic trainers, physical therapists, and a self-efficacy expert reviewed the scale to 1) determine face and content validity and 2) provide suggestions for additions or removal of questions. The decision was made to reduce the response scale to limit patient options from an 11-point scale (0 to 100, increasing in 10 point increments) to a 7-point scale (0 to 6), still with the rating of “Not confident” to “Very confident.” Previous literature has indicated a reduced scale response format provides similar results with the 0 to 100 scale<sup>173,174</sup> and other self-efficacy scales have also used this rating system.<sup>144</sup> Upon scale finalization, a pilot test of the SEHEPS on a convenient sample of 10 patients in a physical therapy clinic was conducted. This confirmed patient understanding, time to complete the scale was approximately 2 minutes, and face validity of the instrument was accomplished.

### *Survey Measures*

#### Self-Efficacy for Home Exercise Programs Scale (SEHEPS)

The SEHEPS (Appendix 5) was designed to evaluate patient self-efficacy toward prescribed HEP. This scale is to be used as a guide for clinicians to individualize patient care for HEPs. This 12-item questionnaire takes approximately two minutes to complete. Seventy-two points are possible on this scale with the option of choosing “NA,” or not applicable. Raw scores were used by calculating the sum of all questions. Patients completed the SEHEPS at three-time points: their initial visit, 24-48 hours following their initial visit, and last day of the study.

#### Self-Efficacy for Exercise

The Self-Efficacy for Exercise (SEE) scale was designed to examine the barriers to exercise self-efficacy in adults. This scale is 9-items asking about an individual’s confidence to exercise for 20 minutes, three times a week, under certain conditions. Typically, responses are rated on a 0-10 point Likert scale, but for this study, it has been reduced to a 7-point Likert scale to eliminate patient options.<sup>175</sup> The researchers made the point modification for consistency of all measures. The SEE was created to assess the ability to exercise in the presence of barriers originally in sedentary adults participating in biking, rowing, and walking.<sup>147</sup> The SEE scale has been identified as reliable and valid within the older adult population with a 10-point scale.<sup>147</sup> Stronger self-efficacy expectations detected using this scale have been associated with better

physical and mental health status.<sup>147</sup> This scale was administered only at the initial visit to examine convergent validity between the SEHEPS and SEE.

#### Pain Self-Efficacy

The Pain Self-Efficacy Questionnaire (PSEQ) is applicable for many patients suffering from persistent pain.<sup>144</sup> This scale was developed to examine individuals' confidence in their ability to complete activities while experiencing pain. The PSEQ has high internal consistency (0.92 Cronbach's alpha) and test-retest reliability (ICC = 0.73).<sup>144</sup> Correlations with pain-related disability and coping strategies have been identified with the PSEQ.<sup>144</sup> Researchers have also utilized this scale to examine the effects of a cognitive behavior intervention on chronic pain.<sup>134</sup> This scale was administered only at the initial visit to examine convergent validity between the SEHEPS and the SEE.

#### Global Rating of Change

The Global Rating of Change (GROC) question is a one-item questionnaire that is rated on a Likert scale ranging from -5 (much worse) to +5 (much better) to determine meaningful change in a patient's condition.<sup>176-178</sup> This questionnaire addresses whether or not the patient feels as though they made improvements through the course of rehabilitation. This measure was used to determine if patients were eligible to be used for reliability testing at 24-48 hours post initial treatment. Patients between -2 and +2 were considered not to have changed and were asked to complete the SEHEPS questionnaire again to evaluate the questionnaire's between-day reliability.<sup>179</sup> Patients outside of this range were not used as they either improved or worsened and reliability of the SEHEPS is affected. The GROC has been previously determined to be reliable and valid.<sup>180</sup>

#### Region-Specific Patient-Reported Outcomes Measures

The patient-reported outcome measures were collected during a patient's physical therapy visit as standard of care. The physical therapists use specific measures for different body regions based on the body part being treated (e.g., Lower Extremity Functional Scale, Oswestry Disability Index, the Disabilities of the Arm, Shoulder, and Hand, and Penn Shoulder Score). These scales, all typically used in physical therapy clinics, have been found to be reliable and valid tools to evaluate patient-centered level of function in patients with musculoskeletal disorders.<sup>181-184</sup> Patient-reported outcome data was collected from the patient records at the initial

visit and again at the third time point to examine the relationship between initial self-efficacy for HEPs and patient-reported outcomes.

### *Participants*

This study included patients who were being treated for a musculoskeletal condition at two university-based physical therapy clinics. Patients were included if they were between the ages of 18-70, were prescribed a HEP, and were expected to be treated for at least two weeks. Patients were excluded if they did not intend to return for follow-up visits or were unable to read English. Patients unable to answer the questions or follow the directions on the questionnaires were also excluded from the study.

### *Study Design and Procedures*

This study examined the psychometric properties of a clinical cohort. Patients were recruited at their initial physical therapy visit at one of two outpatient orthopedic clinics. After being informed of the study and providing verbal and written consent approved by the University of Kentucky, three surveys were administered: the Self-Efficacy for Home Exercise Programs Scale (SEHEPS), the Self-Efficacy for Exercise scale (SEE), and the Pain Self-Efficacy Questionnaire (PSEQ). Exercise frequency was also collected by researchers by asking the patient, “Prior to your injury, in a typical month, how many times do you exercise strenuously (breaking a sweat, breathing hard) for at least 30 minutes?” The three questionnaires took approximately 10 minutes to fill out and were completed after prescription of a HEP (see Appendix 5). Patients were given an exercise log to record their prescribed HEPs over the next 2 - 4 weeks (Appendix 6). This period of two to four weeks was established based on the designated 30-day window for physical therapy progress reports, yet left room for the researcher to follow-up before then if the patient is discharged prior to the required progress report. Instructions were given on how to fill out the exercise log. Participants were asked to return the log at the end of the study.

The following day, patients received an email requesting they complete the GROG and SEHEPS between 24 - 48 hours following their initial visit. The survey was completed in REDCap (Research Electronic Data Capture), a secure, web-based application designed to support data capture for research studies.<sup>185</sup>

The last follow-up occurred between 2 - 4 weeks, per standard of care, at the clinic. At this time point, patients completed the patient-specific functional outcome measure, the SEHEPS,

and a GROC question. Once all questionnaires were completed and their exercise log was returned, the study was complete. Figure 5.1 displays the data collection and analysis time points.

Figure 5.1 Data collection and analysis



### Statistical Analysis

The psychometric properties of SEHEPS were examined. Cronbach's alpha was used to evaluate internal consistency of the instrument. Between day reliability of the SEHEPS was determined using an intraclass correlation coefficient (ICC, 2,1)<sup>186</sup> by having patients repeat the assessment at 24-48 hours post initial examination. Participants were only included if their GROC score did not change as described above. Convergent validity was carried out by examining the correlation between initial SEHEPS, SEE, and PSEQ scores collected at baseline testing. Relationships were examined with a Spearman's rho correlation coefficient between the three initial self-efficacy questionnaires. Correlations below 0.50 were considered weak or low, below 0.7 were moderate, and above 0.70 strong.<sup>187</sup> One of the secondary aims was to determine a cutoff score that could differentiate patients at a 70% adherence rate to a HEPs, a receiver operating characteristic (ROC) curve was used. Seventy percent was chosen as the adherence literature indicates a large range and at the high end 70% of the time patients adhere.<sup>10</sup> The ROC curve was created by plotting sensitivity versus 1 – specificity for scores on the SEHEPS. The balance point, maximizing both sensitivity and specificity, was used to determine the cut score to predict who was likely to be non-adherent. The p-value for the area under the curve was set at  $p = 0.05$ .

A secondary aim of this study was to examine the hypothesis that SEHEPS will positively correlate with patient self-reported adherence rates to HEPs. Due to lack of normality within the data, the researchers examined this relationship with a Spearman's rho correlation coefficient between patient's adherence log and the initial SEHEPS score. The third and final aim of this study was to examine the relationship between initial self-efficacy scores and self-reported

functional changes using a Spearman's rho correlation coefficient. The self-reported outcome scores were transformed to a consistent 100-point scale with a 100 indicating a highest level of function. The change score was used as patients entering the study had various injuries and levels of severity. The change score was calculated as the difference between the final and initial scores with a negative score indicating that the patient's perceived level of function was worsening. All statistical analysis was completed using SPSS statistical software (version 24.0; IBM Corporation, Armonk, NY).

## **Results**

### *Patient Characteristics and Descriptive Statistics*

Eighty-one patients with musculoskeletal conditions volunteered for this study. Only 32 (39.5%) participants returned their exercise log, reporting an average adherence rate of 76%. Patient characteristics are displayed in Table 5.1. This table includes all patients as one group but also separates those who returned their logs (adherent) and those who did not (non-adherent) to examine if differences exist in demographics between the two groups. Independent t-tests were used to evaluate differences between continuous variables (age and previous exercise). Chi-squares were used for dichotomous and categorical variables (sex, race, insurance, socioeconomic status, and previous rehabilitation). Socioeconomic status was determined based on the patient's zip code using the 2017 Distressed Communities Index (DCI).<sup>188</sup> Scores on this index range from 1-100 with a higher score indicating a more distressed community. Typically, the DCI scores are categorized into five groups: prosperous (values below 20), comfortable (values 20-40), mid-tier (values 40-60), at risk (values 60-80), and distressed (values over 80). Due to the small sample size in this cohort, some of the demographic categories had to be compiled as indicated in Table 5.1. For example, socioeconomic status had categories with only one patient, so the three more distressed groups (mid-tier, at risk, and distressed) were compiled for analysis. No differences in age, sex, race, socioeconomic status, or condition were detected between adherent and non-adherent groups (Table 5.1). Patient diagnoses are displayed in Table 5.2. The average score on the SEHEPS at time point one was  $50.9 \pm 13.6$  and  $50.5 \pm 13.1$  at time point three.

### *Reliability*

The internal consistency estimate was deemed to be high ( $\alpha = 0.96$ ) using all 81 participants from the initial visit. Test-retest reliability was calculated using the SEHEPS score at the initial visit and the 24-48 hour follow-up. Seventeen of the 81 participants were eligible for

test-retest reliability. The SEHEPS was found to be reliable between time days (ICC = 0.8, SEM = 5, MDC = 7).

Table 5.1 Patient characteristics (n = 81)

<b>Characteristic</b>	<b>All</b>	<b>Adherent (n = 32)</b>	<b>Non-adherent (n = 49)</b>	<b>p-value</b>
<b>Age (years)</b>				
Mean $\pm$ SD	42 $\pm$ 17	44.2 $\pm$ 17.4	40.4 $\pm$ 17.5	0.35
Range	18 - 69			
<b>Sex (n)</b>				
Male	32	11	21	0.39
Female	49	21	28	
<b>Race</b>				
Caucasian	66	27	39	0.62
Other	25	4	8	
Not reported	3	0	3	
<b>Insurance</b>				
Private	65	24	17	0.60
Public	12	6	6	
Not reported	4	0	4	
<b>Socioeconomic status</b>				
Prosperous	24	13	11	0.16
Comfortable	28	8	20	
Less than comfortable (grouped mid-tier - distressed)	25	9	16	
<b>Post-Surgical Patient</b>				
Yes	31	11	21	0.45
No	51	21	28	
<b>Previous rehabilitation</b>				
Yes	46	22	25	0.23
No	21	6	14	
Not reported	14	0	14	

Table 5.1 (Continued)				
<b>Previous strenuous exercise</b>				
Mean $\pm$ SD	12 $\pm$ 9	12 $\pm$ 8	12 $\pm$ 9	0.99
(sessions/month)				
Range	0 - 30			
Not reported	34	0	34	
<b>SEHEPS initial score</b>				
Mean $\pm$ SD	50.8 $\pm$ 13.6	52.6 $\pm$ 11.6	49.7 $\pm$ 14.7	0.34
Range	20 - 72			
<b>SEE score</b>				
Mean $\pm$ SD	37.3 $\pm$ 10.8	38.9 $\pm$ 9.5	35.9 $\pm$ 11.3	0.21
Range	10 - 54			
<b>PSEQ score</b>				
Mean $\pm$ SD	42.1 $\pm$ 13.7	43.9 $\pm$ 13.1	40.6 $\pm$ 13.9	0.29
Range	8 - 70			

\*“Previous rehabilitation” refers to patients who have attended rehabilitation in the past for the same or different musculoskeletal condition.

Table 5.2 Patient diagnoses

<b>Surgical</b>	<b>n</b>	<b>Non-surgical</b>	<b>N</b>
<b>Diagnosis</b>		<b>Diagnosis</b>	
ACL reconstruction	11	Shoulder pain	14
Meniscus repair	5	Back pain	7
Shoulder repair	5	Ankle sprain	5
Loose body removal from knee	4	Knee pain	6
Total lower extremity arthroplasty	4	Hip pain	5
Medial patellofemoral ligament reconstruction	1	Ankle/foot fracture	3
Metacarpal fracture with percutaneous pinning	1	Neck pain	3
		Achilles tendonopathy	1
		Patellar dislocation	1
		Compartment syndrome	1
		Clavicular fracture	1
		Ankle osteoarthritis	1
		Lateral epicondylitis	1
		Wrist pain	1
Total	31		50



## Validity

The correlations for the assessment of convergent validity were significant and strong between the SEHEPS and SEE scale ( $\rho = 0.83, p < 0.01$ , Figure 5.2). The correlations for the assessment of convergent validity were significant and moderate between the SEHEPS and the PSEQ ( $\rho = 0.31, p < 0.01$ , Figure 5.3). The correlation for the assessment of convergent validity were significant but weak between the SEE and PSEQ ( $\rho = 0.28, p < 0.01$ , Figure 5.4). As a secondary analysis, independent t-tests were run between non-surgical and surgical patients SEHEPS scores at time point one. Results indicate no differences in SEHEPS scores between non-surgical ( $50.8 \pm 12.2$ ) and surgical ( $50.7 \pm 15.7$ ) groups at time point one ( $p > 0.05$ ), increasing external validity of the instrument to both patient populations.

## Cutoff Scores

The ROC curve was constructed to determine a SEHEPS cutoff score to differentiate patients who may not be adherent to their prescribed HEP at 70% level (Figure 5.5). The area under the curve was 0.78 with a standard error of 0.08, which was significant ( $p = 0.008$ ). The cutoff score was determined to be 59 points with a sensitivity of 92% (95% CI 66 – 99) and specificity of 55% (95% CI 40 – 60). The positive likelihood ratio of 2.0 (95% CI 1.1 – 2.5) indicates those who score below 59 points on the SEHEPS would be 2 times more likely to be non-adherent than adherent to their HEP.

Figure 5.2 Correlation between initial SEHEPS score and SEE score

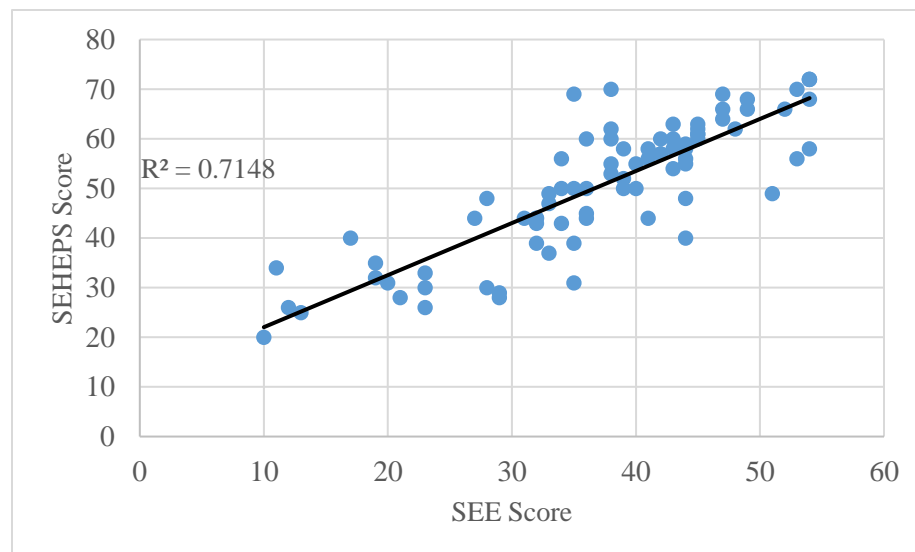


Figure 5.3 Correlation between initial SEHEPS score and PSEQ score



Figure 5.4 Correlation between SEE and PSEQ score

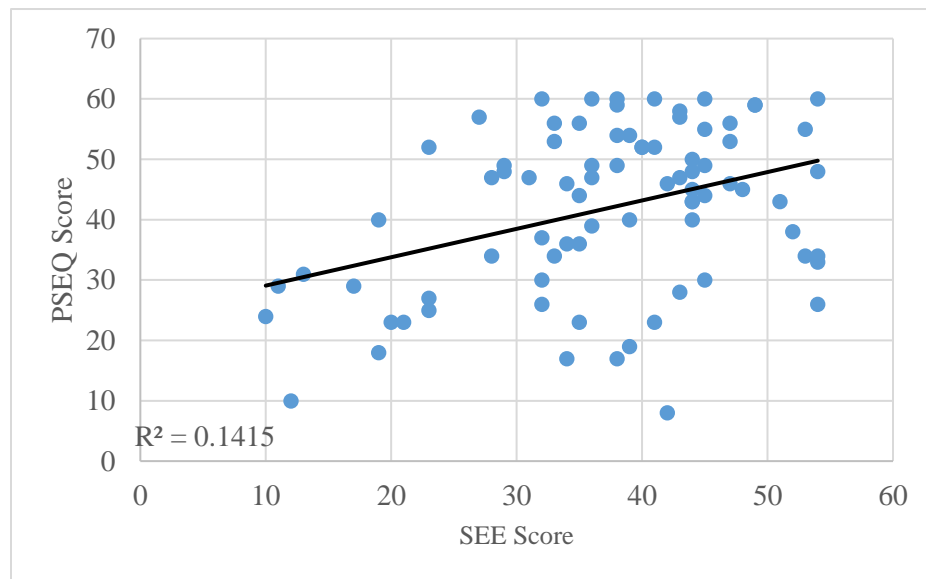
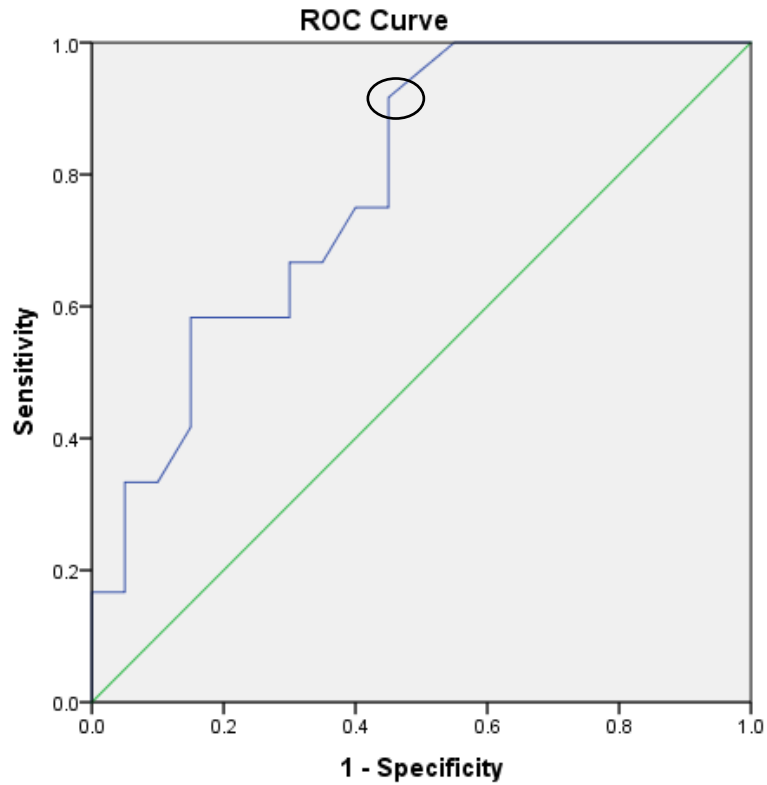


Figure 5.5 ROC curve for the SEHEPS



\*The point closest to the top left corner (circle) is the cutoff point off score that demonstrates the most balance between sensitivity and specificity of those patients likely to be non-adherent to HEP.

#### *Self-Efficacy, Patient Reported Outcomes, and Adherence*

Statistical analysis was then performed only on the 32 individuals who returned their exercise log. The Spearman's rho correlation coefficient between SEHEPS at time point one and program adherence was significant ( $n = 32$ ,  $\rho = 0.38$ ,  $p = 0.03$ , Figure 5.6). The relationship between SEHEPS at time point one and patient reported outcome change score was not significant ( $n = 52$ ,  $\rho = 0.22$ ,  $p = 0.11$ , Figure 5.7).

Figure 5.6 Correlation between initial SEHEPS score and adherence to HEP

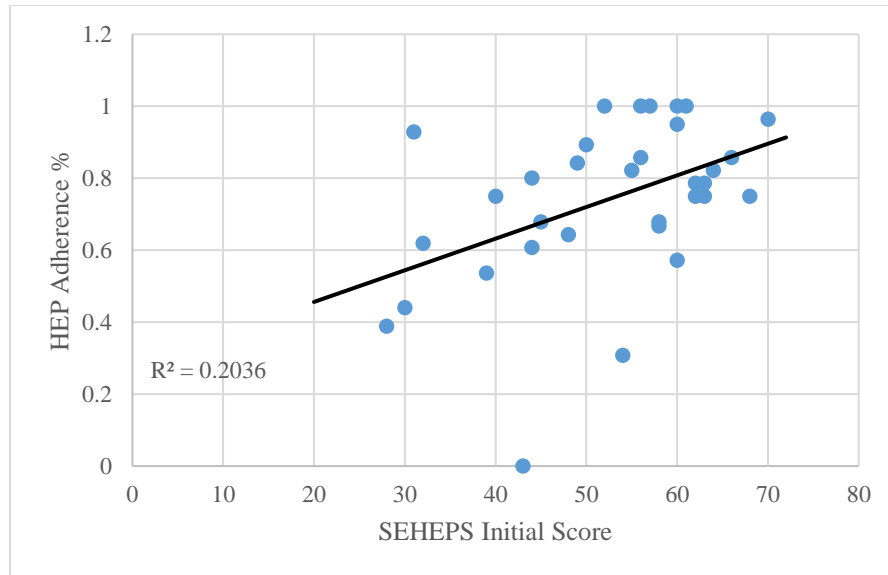
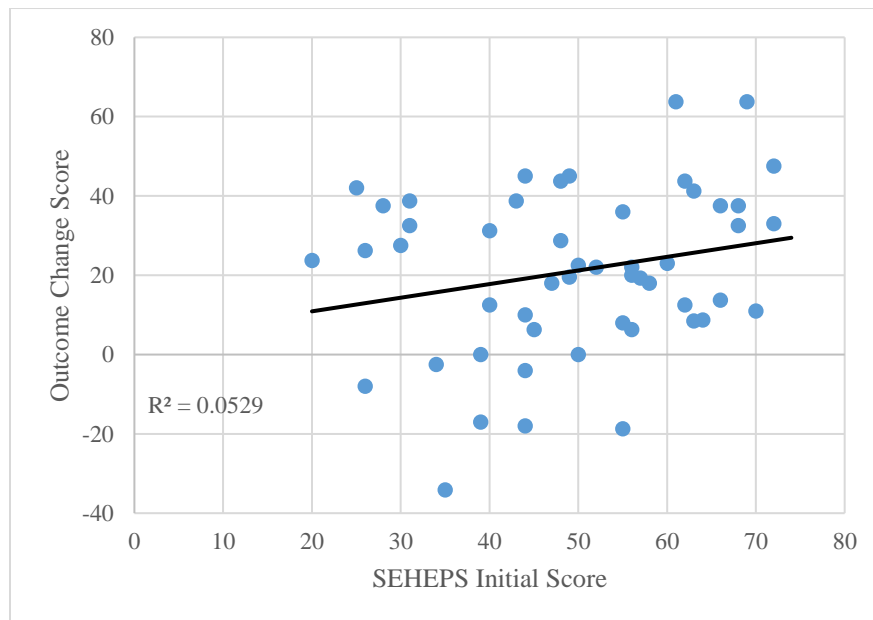


Figure 5.7 Correlation between initial SEHEPS percent score and outcome change score



### Missing Data

Seven patients choose the “NA” option on the initial SEHEPS at least once, two of which returned their exercise logs. There was a concern about how to handle missing data, however, the relationship between self-efficacy and HEP adherence was conducted both with ( $n = 30$ ) and

without ( $n = 32$ ) missing data to find the results did not differ if included ( $r = 0.38$ ,  $p = 0.03$ ) or excluded ( $r = 0.39$ ,  $p = 0.04$ ).

## Discussion

Patient adherence to HEPs has been reported as low as 13%.<sup>10,12</sup> The assessment of patient barriers, such as low self-efficacy, is essential for improving and individualizing care. This study provides a newly developed scale with strong psychometric properties to aid in assessing patients' self-efficacy for HEPs. Results of this study have indicated the SEHEPS is a reliable and valid tool to assess self-efficacy in both a musculoskeletal surgical and non-surgical patient population participating in HEPs. Clinically, assessment of self-efficacy using this scale may aid in determining which patients may not be adherent to their HEP.

The SEHEPS has excellent internal consistency. A consideration for use of this scale should be taken under advisement as an acceptable Cronbach's  $\alpha$  varies between research and clinical use.<sup>48</sup> With a Cronbach's  $\alpha$  of 0.96, this scale would be suitable for both research and clinical application. Compared to other self-efficacy scales, our internal consistency is slightly higher. The higher Cronbach's  $\alpha$  may indicate the items in the scale do not provide enough variance and reduction of items may be possible. Future studies may work to reduce the items in this scale using a factor analysis technique. A scale with less items would save both the patient and clinician time, yet provide valuable information for further individualization of care. Other self-efficacy measures such as the SEE and the PSEQ also have excellent internal consistency values of 0.92,<sup>144,147</sup> but this is the first scale to specifically assess self-efficacy for HEPs.

The good test-retest reliability of the SEHEPS separates this scale from the other self-efficacy assessment tools. Only four self-efficacy scales used within the musculoskeletal literature provided a value for test re-test reliability.<sup>142-144, 1446</sup> The test re-test reliability of the SEHEPS is considered to be good,<sup>189</sup> and higher than that of the PSEQ (ICC = 0.73), and similar to the Arthritis Self-Efficacy Scale (ICC = 0.85 – 0.90).<sup>142</sup> The good reliability indicates the SEHEPS is a stable assessment tool for assessing self-efficacy for HEPs. Having established test-retest reliability is a benefit of this scale as most self-efficacy assessments, such as the SEE, do not report or provide this psychometric property. Clinicians using this scale can be confident in the good representation of self-efficacy for HEPs with confidence in its stability over time. It is important that clinicians have reliable measures to assess patient self-efficacy for HEPs as this may aid in individualization of care. The SEM equal to five and MDC of seven are reasonable values, as they do not exceed 10% error of the total score of the instrument. This is consistent among other patient reported scales used in musculoskeletal injuries.<sup>180-183</sup> Establishment of this

values are important to future researchers to potentially use this scale when attempting to assess the effectiveness of a self-efficacy intervention to improve functional outcomes or adherence. When utilizing this tool to assess self-efficacy for a HEP, a seven-point change must occur in a patient's total score to indicate a clinically meaningful change in a patient's self-efficacy toward a HEP.

Similar to other self-efficacy scales, the SEHEPS has face, content, and convergent validity. A strong, positive correlation ( $\rho = 0.83$ ) was detected between the SEHEPS and the SEE and is consistent with our hypothesis. Unexpected, a weaker correlation ( $\rho = 0.31$ ) was found between the SEHEPS and PSEQ. This may be due to the fact that PSEQ questions relate to pain during other activities besides exercise alone, whereas the SEHEPS is specific to HEPs. A secondary analysis found that the SEE had a similar relationship to the PSEQ ( $\rho = 0.28$ ,  $p < 0.01$ ), which may also be a result of the different tasks in question. These results provide support for the SEHEPS as measuring the construct of self-efficacy relating to exercise over pain.

This scale was created with the intent of specifically measuring self-efficacy as it pertains to HEPs to help clinicians better decipher who may be non-adherent to their prescribed program. At initial visit, patients who scored less than the 59-point cutoff score on the SEHEPS were two times less likely to adhere to their HEP. The relationship is significant and moderate ( $\rho = 0.38$ ) which is just as strong as previous self-efficacy studies that have examined the same relationship. Although our small sample may have contributed to this correlation, Mannion et al.<sup>138</sup> also examined 32 patients finding a slightly weaker correlation ( $r = 0.36$ ) between adherence and home exercise when assessing with the Exercise Self-Efficacy Scale. The relatively low correlation may be due to the specificity of the task inquired about in the new scale. Other studies examining the relationship between exercise self-efficacy and adherence have found positive yet, weak to moderate relationships ( $r = 0.30$  to  $0.39$ ).<sup>32,78,127,138</sup> Many of these studies used a Pearson correlation coefficient to examine these relationships, whereas this study used a Spearman correlation coefficient. The use of the Spearman correlation coefficient may have produced slightly different values than the Pearson correlation coefficient. The data in this study were not normally distributed, per recommendations, a Spearman correlation coefficient was used.<sup>190</sup> Lower self-efficacy may result in decreased adherence to both clinic-based adherence and attendance to physical therapy treatments.<sup>191</sup> These results illustrate that self-efficacy is a construct that may impact maintenance and adherence to rehabilitative exercise.<sup>97</sup> The current study provides a more task-specific scale for assessing self-efficacy for HEPs.

This study did not find evidence to suggest a strong relationship between self-efficacy at the initial visit and the change in patient-reported outcome measures. The lack of relationship may be a result of the variety of both surgical and non-surgical diagnoses included in this cohort of participants. The initial visit patient-reported outcome scores of a surgical participant shows greater impairments (Table 5.2). In addition, the short duration of follow-up in this study may not have been enough time to capture significant improvements in participants with more severe diagnoses. Recovery from surgical procedures takes more than the four week window that was used in this study. Additionally, HEP self-efficacy may not be related to patient-reported outcome measures as the exercises are prescribed with the intent of the patients being able to complete successfully. Patient-reported outcome measures inquire about everyday functioning and pain based on the injured body segment. Unlike our findings, a systematic review from 2014 examined the relationship between self-efficacy and pain outcome measures finding moderate, negative significant relationships.<sup>192</sup> Patients who reported higher levels of self-efficacy were found to experience less pain, impairments, and distress when compared to those who reported lower self-efficacy.<sup>192</sup> Other studies indicate that rehabilitative success is influenced by patient adherence to treatment and exercise prescription with improved outcomes found in various patient populations.<sup>11,14,45</sup> As a secondary correlation analysis, this study did not find a relationship between HEP adherence and patient-reported outcome measures ( $n = 26$ ,  $\rho = 0.26$ ,  $p = 0.42$ ). Of the 32 patients who returned their exercise log, three self-discharged and three were discharged prior to their four-week follow-up with the physical therapist, meaning there were no follow-ups of the patient-reported outcome measures, further diminishing our sample size for this analysis. A previous study examined this relationship in patients with osteoarthritis found that at all timepoints (3, 15, and 60 months), those who were more adherent had better outcomes.<sup>14</sup> Unlike our study, this study had, not only a larger sample size ( $n = 150$  vs  $n = 25$ ) but also followed these patients for a longer duration of time. Future work in this area should extend follow-up periods and focus on individual diagnoses.

When making clinical decisions regarding patient's adherence to HEPs, the SEHEPS may help clinicians discriminate between those who may not be at least 70% adherent. The balance point of sensitivity and specificity on the SEHEPS identified a cutoff score of 59, classifying 22 out of 32 patients correctly. These results further indicate that a patient who scores less than 59 points on the SEHEPS will be 2 times more likely to be non-adherent to their HEP, aiding clinicians to pursue early interventions to improve patient self-efficacy or modify HEP to assure exercise adherence. For the average patient who scores 50 points on the SEHEPS, an improvement of as little as seven points would place them closer to the 59-point cutoff score, in

turn, making them less likely to be non-adherent. Previous studies have found goal setting, providing systematic feedback, additional social support through text messages or email, and education enhancing behavioral change or self-management have been found to increase patient self-efficacy, in turn, adherence.<sup>40,41,43,135,137</sup> After administration of the SEHEPS at initial visit, any of these interventions may be incorporated easily into standard of care with the possibility of significant improvements in adherence to HEPs.

This study is not without limitations. Without the patients' exercise logs, the researchers are unable to decipher if the results were skewed between initial visit self-efficacy and adherence to HEPs or even patient-reported outcome measures effecting the relationship. Despite numerous attempts to obtain these logs, patients claimed to have lost their logs or no longer wished to participate. Another construct to consider within social cognitive theory that may play a role in this low return of exercise logs is self-regulation. Bandura suggests that self-regulation is becoming a key factor in certain aspects of life and "people are not eager to shoulder the burdens of responsibility," (p. 13).<sup>87</sup> May it be the act of completing a HEP or simply returning an exercise log, some individuals may not self-regulate or manage these tasks as the should to improve his or her condition. Low response rates are a common problem in human research,<sup>193</sup> and this study was no exception. The data collected at initial visit were not affected by this as internal consistency and validity were not reliant on response rate. Additionally, no control was provided for a variety of variables such as care provided by the clinicians, progression of therapy, or patient diagnoses. The researchers aimed to examine the use of this instrument in standard physical therapy care in a musculoskeletal setting. Future studies should account for these variables, as some patients may respond better to self-efficacy interventions. This scale should be refined with further research through factor analysis, item reduction, and confirmatory analysis. Use of this scale when implementing a self-efficacy intervention to stratify patients into groups based on level of self-efficacy should also be considered.

## **Conclusions**

The SEHEPS demonstrates excellent internal consistency, test re-test reliability, and strong convergent validity with the SEE scale providing further support for the psychometric properties of this novel instrument. The SEHEPS may be a clinically useful tool for evaluating a patient's self-efficacy for home-based musculoskeletal exercise programs in outpatient physical therapy clinics as a cut score was determined and indicates twice the risk of non-adherence if a patient scores below a 59. This study has provided evidence to support the use of the SEHEPS in a musculoskeletal patient population. This study created and tested a new survey tool to help



clinicians assess patient's self-efficacy for completing a prescribed HEP. The creation of the scale provides a first step toward facilitating a patient's adherence to his or her exercise prescription and, in turn, the potential for successful rehabilitation outcomes.

## **Chapter 6: Summary**

The purpose of this dissertation was to determine how the concept of self-efficacy is used by clinicians in musculoskeletal rehabilitation when individualizing patient treatment. This dissertation was comprised of three studies with multiple aims. Overall the goal was to investigate the assessment and use of patients' self-efficacy by clinicians to improve the issue of <50% adherence with rehabilitation programs and evaluate the effectiveness of a new tool devised by the authors to assess self-efficacy toward prescribed home exercise programs (HEPs). The specific aims and findings for each of the three studies are detailed below.

### **Specific Aims and Findings for Measurements of Self-Efficacy in Musculoskeletal Rehabilitation: a Systematic Review**

Aim 1: To determine what self-efficacy scales are being used in conjunction with exercise adherence.

Finding: Fourteen self-efficacy scales were extracted from the 29 studies included within this systematic review. The scales identified were primarily condition- or task-specific scales, however, some do not fall into either of those categories and include the General Self-Efficacy Scale, Ewart's Scale of Self-Efficacy, and the Health Belief Model. The most common scale used was the Arthritis Self-Efficacy Scale used primarily in osteoarthritis research studies.

Aim 2: To identify if any self-efficacy scale has been developed to specifically assess self-efficacy for HEPs

Findings: The scales identified were primarily condition- or task-specific scales, but none of the 14 scales were task-specific to HEPs. To the author's knowledge, no scale exists to assess self-efficacy for HEPs.

Aim 3: To determine the psychometric properties of each scale identified.

Findings: Many of the self-efficacy scales used in these and other studies have demonstrated sufficient internal consistency values (Cronbach's  $\alpha = 0.75-0.94$ ), but lack evidence of test-retest reliability and validity. Validity was evaluated in seven out of 14 self-efficacy scales and consisted of content or construct validity.

Aim 4: To determine which scales are being used to predict adherence to rehabilitation exercise.

Findings: Self-efficacy has been used to predict adherence behaviors. The Self-Efficacy for Exercise scale has been correlated class attendance, but not home practice with self-efficacy for

exercise. The lack of relationship found in this study further indicates the need for a measure specific to HEPs.

### **Hypotheses and Findings for Physical Therapists Assessment of Patient Barriers to Rehabilitation Adherence**

Hypothesis 1: Physical therapists will not recognize self-efficacy as one of the top three barriers to patient adherence to HEPs.

Finding: This hypothesis was accepted, as self-efficacy was not in the top three observed or most negatively influential patient barriers. Fifty percent of physical therapists in this cohort find self-efficacy to be very to extremely important, however, other barriers seem to be more prevalent and influential to this cohort of 462 physical therapists. The top three most often observed patient barriers were reported as lack of time, forgetting to complete HEP and low levels of physical activity at baseline. The top patient barrier ranked as most negatively influential was anxiety and depression, with no differences in rank of the second most negatively influential barrier.

Hypothesis 2: Physical therapist will report using observation to assess self-efficacy at least 50% of the time.

Finding: This hypothesis was rejected, as verbal discussion was selected as the most common method of self-efficacy assessment (50%), followed by observing the patient (38%), patient self-report questionnaires (10%), and other methods (2%). Verbal discussion and patient observation were selected together 170 times accounting for 91% of those who selected two responses.

Hypothesis 3: Physical therapists will report a lack of time as the most common barrier for not assessing self-efficacy for HEPs.

Finding: This hypothesis was rejected, as 40% of physical therapists report they do not assess self-efficacy for HEPs because they do not know how to assess self-efficacy.

### **Hypotheses and Findings from the Self-Efficacy for Home Exercise Programs Scale Development and Psychometric Properties**

Hypothesis 1: The SEHEPS will have good to excellent internal consistency ( $\alpha > 0.80$ ), have acceptable test re-test reliability ( $ICC > 0.70$ ), and will have a significant positive relationship with the Self-Efficacy for Exercise and Pain Self-Efficacy Questionnaire.

Finding: This hypothesis was accepted, as results showed excellent internal consistency, good test re-test reliability, a strong and significant correlation with the SEE ( $\rho = 0.83$ ), and a weak and significant correlation with the PSEQ ( $\rho = 0.31$ ).

Hypothesis 2: Self-efficacy for HEPs will positively correlate with reported adherence rates.

Finding: This hypothesis was accepted, the SEHEPS was found to be moderately correlated with HEP adherence ( $\rho = 0.38$ ).

Hypothesis 3: Self-efficacy scores on the SEHEPS would correlate positively with self-reported functional changes.

Finding: The hypothesis was rejected, there was no relationship found between scores on the SEHEPS and self-reported functional changes ( $\rho = 0.22$ ,  $p = 0.11$ ).

### **Synthesis and Application of Results**

The overall purpose of this dissertation was to determine how the concept of self-efficacy is used by clinicians in musculoskeletal rehabilitation when individualizing patient HEPs. Because it was determined that no tool currently exists to assess self-efficacy for HEPs and the number one barrier to assessing is not knowing how to assess, the Self-Efficacy for Home Exercise Programs Scale (SEHEPS) was created.

To determine what is currently being used to assess self-efficacy within the literature as systematic review was conducted. Fourteen self-efficacy scales were extracted from the included articles with the Arthritis Self-Efficacy Scale most commonly used. The majority of scales had excellent internal consistency and established validity, but lacked test re-test reliability. No scale was found to specifically assess self-efficacy for HEPs. Additionally, the scales currently used to assess self-efficacy for exercise or HEPs only moderately correlate with adherence increasing the need for a more task-specific instrument for HEP self-efficacy be developed.

To determine how physical therapists are assessing patient self-efficacy for HEPs or why they are not, a survey-based study was conducted. Findings suggest that over 50% of physical therapists find self-efficacy to be influential in patient adherence to rehabilitation and even more actually assess prior to prescribing a HEP. The most common method of assessment reported was verbal discussion followed by observation, often these two are used in combination with another. Unfortunately, neither method of assessment has been found to be reliable or valid measures of self-efficacy assessment. Most importantly, those who do not assess self-efficacy prior to prescribing HEPs report not knowing how to assess is the construct. This may be due to the fact that currently no scale to assess self-efficacy for HEPs exists. It is clear from this finding a deficit in our education process needs to be addressed to better inform clinician of the importance of

assessing and enhancing self-efficacy for a patient to be adherent with their HEP. There is also the need to develop a scale to specifically assess self-efficacy for HEPs.

The foundation for the third study came from results of the first and second study in this dissertation. The Self-Efficacy for Home Exercise Programs (SEHEPS) was developed to help clinicians identify who may not be adherent to their HEPs. The SEHEPS has been found to be a reliable scale with have high internal consistency ( $\alpha = 0.96$ ) and good test re-test reliability (ICC = 0.8, SEM = 5, MDC = 7). The correlations were significant and strong between the SEHEPS and SEE scale ( $\rho = 0.83, p < 0.01$ ) and significant and moderate between the SEHEPS and the PSEQ ( $\rho = 0.31, p < 0.01$ ) in the assessment of convergent validity. Unlike other self-efficacy measures, the SEHEPS has a cutoff score of 59 that may help clinicians in deciphering which patients may not be adherent to their HEP. The importance of performing an assessment of patient's self-efficacy during physical therapy evaluation or prior to prescription of a HEP cannot be understated in regards to adherence to their exercise prescription and, in turn, their potential for successful rehabilitative outcomes. Barriers to rehabilitation exercise adherence, specifically self-efficacy, need to be identified to increase adherence, improve patient outcomes, and reduce the financial burden. Future research should consider item reduction of this new scale and use within randomized control trials that seek to decipher adherers from non-adherers.

## Appendices

### Appendix A. Modified Downs and Black checklist for assessing quality of studies

No.	Question	Yes=1	No=0
<b>Reporting</b>			
1	Is the hypothesis/aim/objective of the study clearly described?		
2	Are the main outcomes of the study clearly described?		
3	Are the characteristics of the patients included in the study clearly described?		
4	Are the main findings of the study clearly described?		
5	Does the study provide estimates of the random variability in the data for the main outcomes?		
6	Have actual probability values been reported (e.g. 0.045 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?		
<b>External Validity</b>			
7	Where the subjects asked to participate in the study representative of the entire population from which they were recruited?		
8	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?		
<b>Internal Validity</b>			
9	Were the statistical tests used to assess the main outcomes appropriate?		
10	Were the Main outcome measures used accurate (valid and reliable)?		

## Appendix B. PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Yes- 35
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Yes- will be included in journal submission
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Yes- 35-36
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Yes- 36-37
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	37, no registration #
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Yes- 37
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Yes- 37
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Yes- 37, figure 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Yes-37-39
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Yes-39
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Yes-38-39

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Yes
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Yes- 39
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	NA

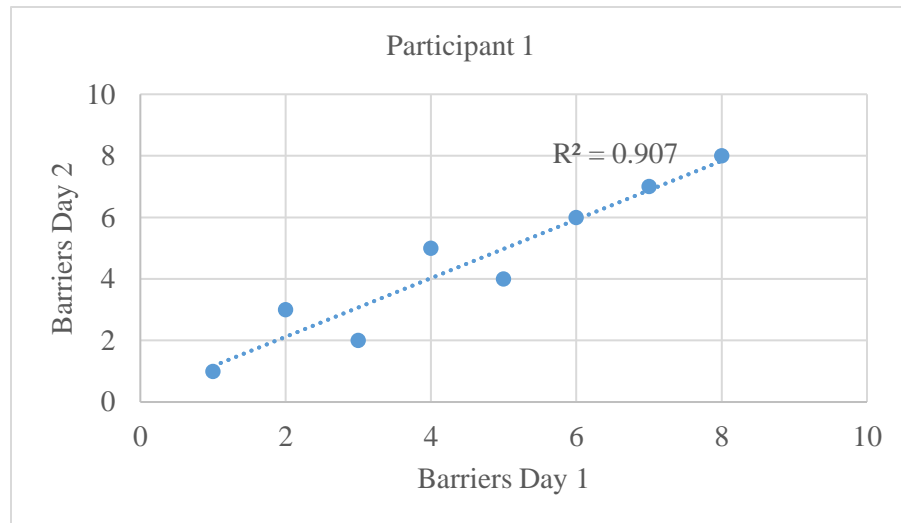
Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Yes
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Yes-39,40
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Yes-44-51
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Yes-60
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Tables
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Yes-60
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
<b>DISCUSSION</b>			



Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Yes- 55, 59-60
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Yes- 60-61
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Yes- 61
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	No

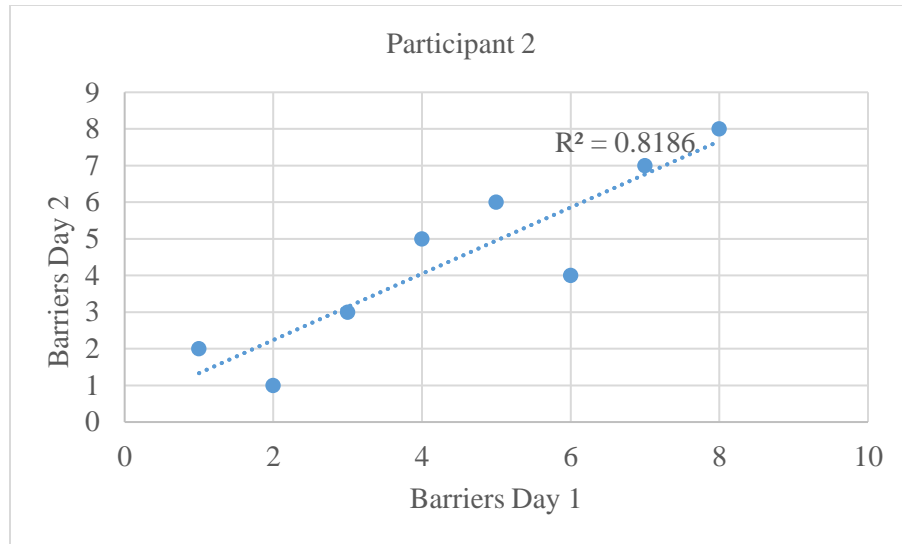
### Appendix C. Graphs displaying four participants rank order responses between days

Question 4- “Clinically, how often do you observe the following patient reasons or barriers to not completing their prescribed exercise? Rank the following reasons or barriers from 1 (most often/common) to 8 (least often/common).”



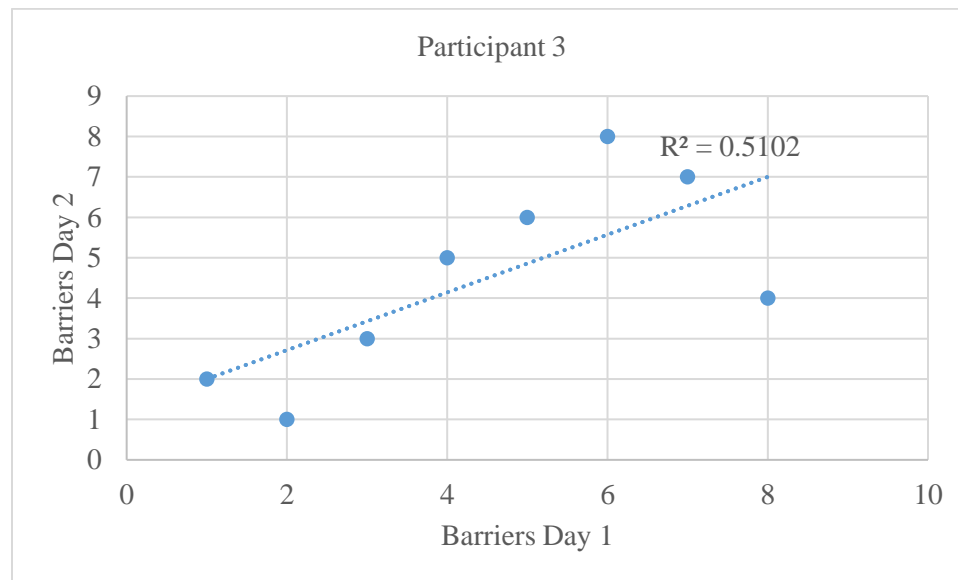
On x-axis 1 = Lack of time, 2 = low self-efficacy, 3 = lack of social support, 4 = low levels of activity at baseline, 5 = pain with exercise, 6 = anxiety/depression, 7 = helplessness, 8 = forgetting

On x-axis 1 = Lack of time, 2 = lack of social support, 3 = low self-efficacy, 4 = pain with exercise, 5 = low levels of activity at baseline, 6 = anxiety/depression, 7 = helplessness, 8 = forgetting



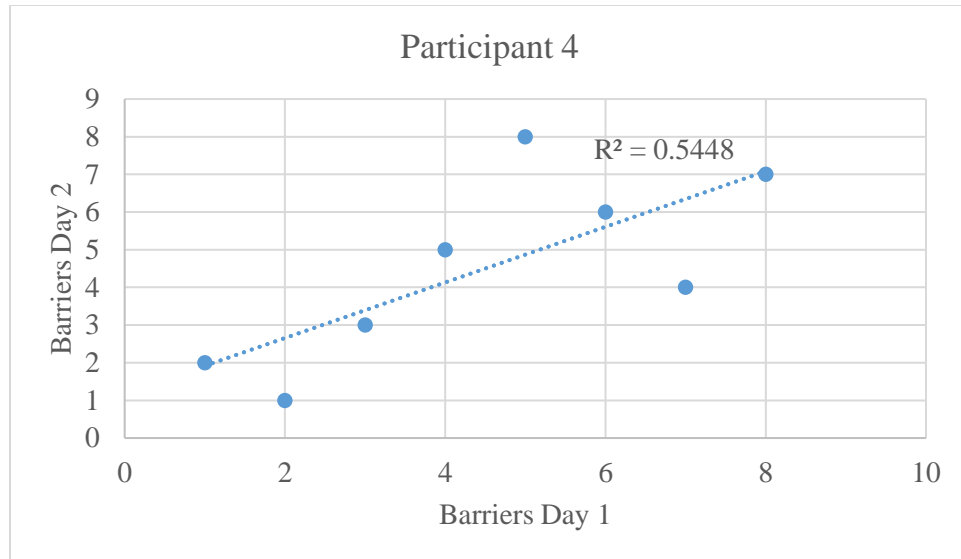
On x-axis 1 = Forgetting, 2 = lack of time, 3 = pain with exercise, 4 = low self-efficacy, 5 = anxiety/depression, 6 = helplessness, 7 = low levels of activity at baseline, 8 = lack of social support

On y-axis 1 = Lack of time, 2 = forgetting, 3 = pain with exercise, 4 = helplessness, 5 = low self-efficacy, 6 = anxiety/depression, 7 = low levels of activity at baseline, 8 = lack of social support



On x-axis 1 = Forgetting, 2 = lack of time, 3 = pain with exercise, 4 = low self-efficacy, 5 = anxiety/depression, 6 = helplessness, 7 = low levels of activity at baseline, 8 = lack of social support

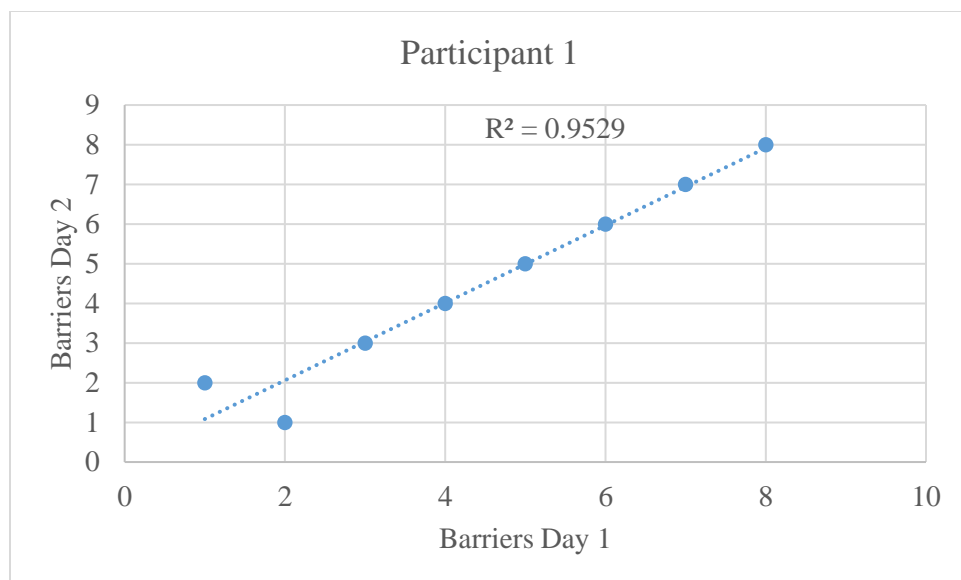
On y-axis 1 = Lack of time, 2 = forgetting, 3 = pain with exercise, 4 = lack of social support, 5 = low self-efficacy, 6 = anxiety/depression, 7 = low levels of activity at baseline, 8 = helplessness



On x-axis 1 = Lack of time, 2 = Forgetting, 3 = pain with exercise, 4 = low self-efficacy, 5 = low levels of activity at baseline, 6 = lack of social support, 7 = helplessness, 8 = anxiety/depression

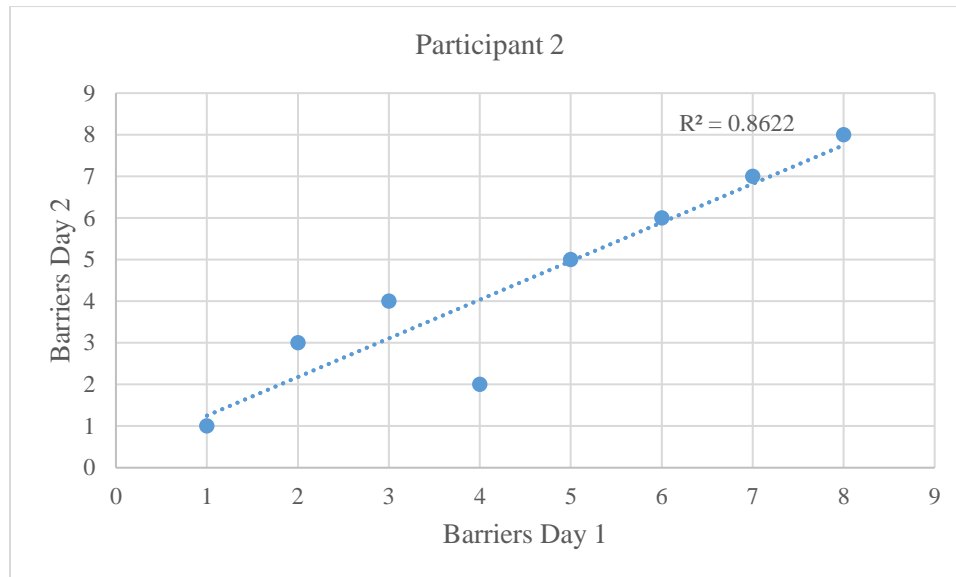
On y-axis 1 = Forgetting, 2 = Lack of time, 3 = pain with exercise, 4 = helplessness, 5 = low self-efficacy, 6 = lack of social support, 7 = anxiety/depression, 8 = low levels of activity at baseline

Question 5- “From your clinical perspective, rank the reasons or barriers you feel as most negatively influential to a patient's adherence. Rank the following reasons or barriers from 1 (having the most negative impact) to 8 (having the least negative impact).”



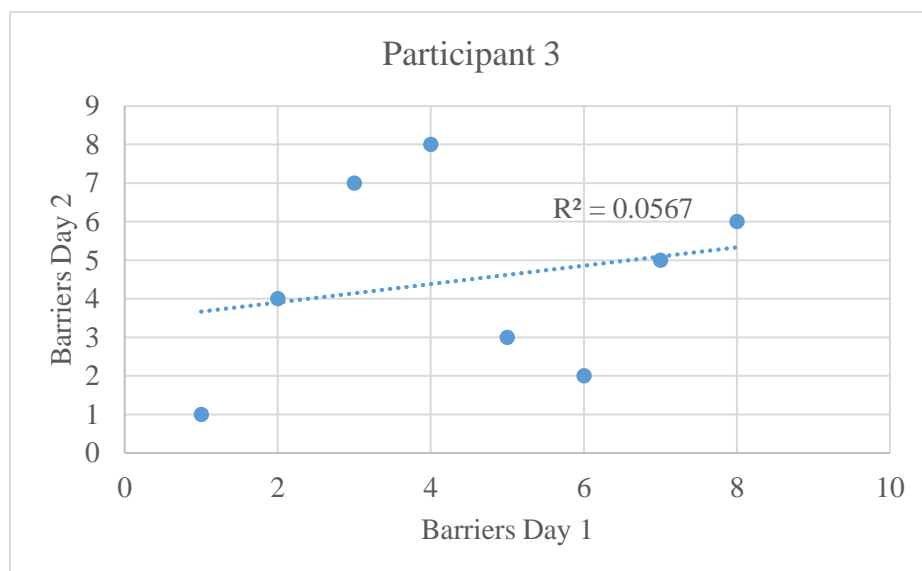
On x-axis 1 = Lack of social support, 2 = lack of time, 3 = low self-efficacy, 4 = low levels of activity at baseline, 5 = anxiety/depression, 6 = pain with exercise, 7 = helplessness, 8 = forgetting

On y-axis 1 = Lack of time, 2 = lack of social support, 3 = low self-efficacy, 4 = low levels of activity at baseline, 5 = anxiety/depression, 6 = pain with exercise, 7 = helplessness, 8 = forgetting



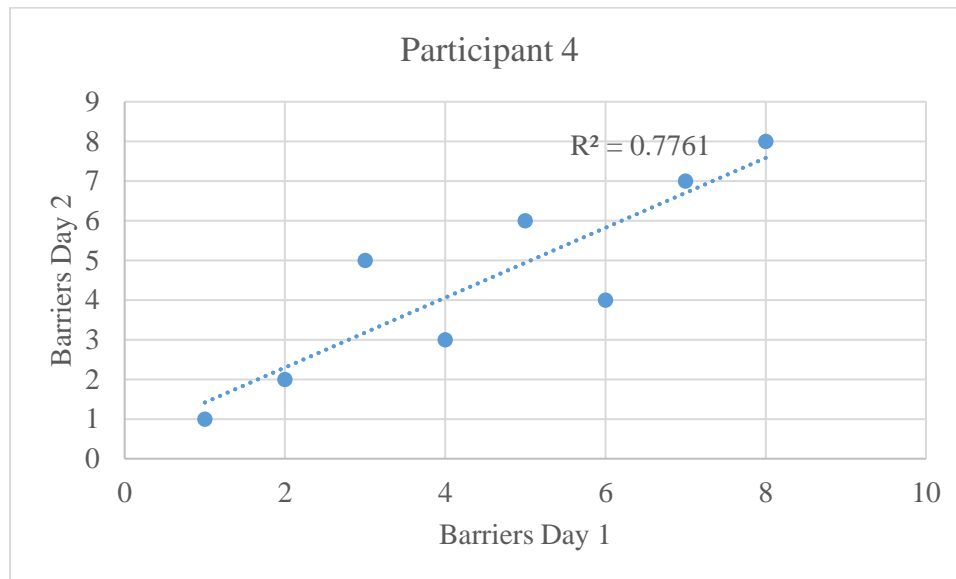
On x-axis 1 = Low self-efficacy, 2 = pain with exercise, 3 = forgetting, 4 = lack of time, 5 = anxiety/depression, 6 = helplessness, 7 = low levels of activity at baseline, 8 = lack of social support

On y-axis 1 = Low self-efficacy, 2 = lack of time, 3 = pain with exercise, 4 = forgetting, 5 = anxiety/depression, 6 = helplessness, 7 = low levels of activity at baseline, 8 = lack of social support



On x-axis 1 = Low self-efficacy, 2 = pain with exercise, 3 = forgetting, 4 = lack of time, 5 = anxiety/depression, 6 = helplessness, 7 = low levels of activity at baseline, 8 = lack of social support

On y-axis 1 = Low self-efficacy, 2 = helplessness, 3 = anxiety/depression, 4 = pain with exercise, 5 = low levels of activity at baseline, 6 = lack of social support, 7 = forgetting, 8 = lack of time



On x-axis 1 = Low self-efficacy, 2 = lack of social support, 3 = low levels of activity at baseline, 4 = helplessness, 5 = pain with exercise, 6 = anxiety/depression, 7 = forgetting, 8 = lack of time

On x-axis 1 = Low self-efficacy, 2 = lack of social support, 3 = helplessness, 4 = anxiety/depression, 5 = low levels of activity at baseline, 6 = pain with exercise, 7 = forgetting, 8 = lack of time

## **Appendix D. Clinician survey**

### **Clinician Utilization of Patient Barriers**

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Welcome!

Before we begin, we want to make sure you are informed about the nature of this study. Please read the following consent form carefully. If you have questions, please email [kelsey.picha@uky.edu](mailto:kelsey.picha@uky.edu) before proceeding.

**Who is doing the study?** The person in charge of this study is Kelsey Picha, MS, ATC in the Department of Rehabilitation Sciences at the University of Kentucky. Kelsey is a current doctoral student conducting this project under the advisement of faculty advisor Tim Uhl, Ph.D., PT, ATC.

**What is the purpose of this study?** The purpose of this study is to evaluate healthcare providers familiarity and assessment of patient barriers to rehabilitation adherence.

**How long will this survey take?** This survey will take approximately 5-10 minutes to complete.

**Where will my data be stored?** Data will be stored in Qualtrics. This is a secure, web-based application designed to support data capture for research studies.

**Is there a benefit to participating in this survey study?** Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about clinician use of patient barriers to rehabilitation adherence.

**Are there any risks to participating in this study?** There are no risks to this study. Your responses are voluntary and do not induce risk. There is an unlikely chance of a breach of confidentiality since we do not ask for name or personal identification numbers. Email addresses will be kept in Qualtrics with only the investigators having access.

There are no alternatives for not taking part in this study.

Refusal to participate will involve no penalty. You may withdraw anytime. Questions may be skipped if you choose not to answer.

Upon completion of this survey, you will have the opportunity to be placed into a drawing for one of two \$25 gift cards to Amazon.com. We are surveying approximately 3,000 people with the understanding from previous research that the response rate is 25-30%. Therefore, the odds of

winning a gift card are approximately 2 out of 750.

Thank you in advance for your assistance with this important project.

Sincerely,  
Kelsey Picha  
Rehabilitation Sciences, University of Kentucky  
kelsey.picha@uky.edu

---

By clicking "I agree" you are providing your consent to participate in this research project

☐ I agree (1)

☐ I do not agree (2)

*Skip To: End of Survey If By clicking "I agree" you are providing your consent to participate in this research project = I do not agree*

End of Block: Block 4

---

Start of Block: Default Question Block

Are you aware of the reasons (or known barriers) patients do not complete their exercise programs you prescribe?

☐ Yes (1)

☐ No (2)

---



From the following list, which reasons do you recognize as patient barriers to exercise adherence? (Check all that apply)

- ☐ Anxiety or depression (1)
  - ☐ Forgetting to complete exercises (2)
  - ☐ Feelings of helplessness or lack of independence (3)
  - ☐ Increased pain during exercises (4)
  - ☐ Low self-efficacy or lack of confidence (5)
  - ☐ Sedentary or low levels of physical activity at baseline (6)
  - ☐ Lack of or poor social support (7)
  - ☐ Lack of time (8)
- 

Clinically, how often do you observe the following patient reasons or barriers to not completing their prescribed exercise? Rank the following reasons or barriers from 1 (most often/common) to 8 (least often/common).

- \_\_\_\_\_ Anxiety or depression (1)
  - \_\_\_\_\_ Forgetting to complete exercises (2)
  - \_\_\_\_\_ Feelings of helplessness or lack of independence (3)
  - \_\_\_\_\_ Increased pain during exercises (4)
  - \_\_\_\_\_ Low self-efficacy or lack of confidence (5)
  - \_\_\_\_\_ Sedentary or low levels of physical activity at baseline (6)
  - \_\_\_\_\_ Lack of or poor social support (7)
  - \_\_\_\_\_ Lack of time (8)
-

From your clinical perspective, rank the reasons or barriers you feel as most negatively influential to a patient's adherence. Rank the following reasons or barriers from 1 (having the most negative impact) to 8 (having the least negative impact).

- \_\_\_\_\_ Anxiety or depression (1)
- \_\_\_\_\_ Forgetting to complete exercise (2)
- \_\_\_\_\_ Feelings of helplessness or lack of independence (3)
- \_\_\_\_\_ Increased pain during exercise (4)
- \_\_\_\_\_ Low self-efficacy or lack of confidence (5)
- \_\_\_\_\_ Sedentary or low levels of physical activity at baseline (6)
- \_\_\_\_\_ Lack of or poor social support (7)
- \_\_\_\_\_ Lack of time (8)

Relative to other barriers, how much of an influence or importance do you feel a patient's self-efficacy or lack of confidence has on their adherence to exercise?

Use the slider to rate the influence of a patient's self-efficacy (1)	
---	--

Do you assess the reasons or barriers patients have for not completing their prescribed exercise?

- ☐ Yes (1)
- ☐ No (2)

*Display This Question:*

*If Do you assess the reasons or barriers patients have for not completing their prescribed exercise? = Yes*

In what ways do you assess the following reasons or barriers to patient exercise adherence?

	Verbal discussion (1)	Patient self- reported questionnaires (2)	Observation during exercise (3)	I do not assess this barrier (4)	Other (5)
Anxiety or depression (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forgetting to complete exercise (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feelings of helplessness or lack of independence (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased pain during exercise (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low self- efficacy or lack of confidence (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sedentary or low levels of physical activity at baseline (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of or poor social support (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of time (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*Display This Question:*

*If in what ways do you assess the following reasons or barriers to patient exercise adherence? = Other*

In the previous question, you answered that you assess through "other" method. Please explain any other methods you use to assess patient reasons or barriers for not completing their prescribed exercise.

---

---

*Display This Question:*

*If Do you assess the reasons or barriers patients have for not completing their prescribed exercise? = Yes*

Once you've assessed the patient reasons or barriers to not completing their prescribed exercise, what do you do with that information?

---

---

*Display This Question:*

*If Do you assess the reasons or barriers patients have for not completing their prescribed exercise? = No*

Why do you not assess patient reasoning or barriers to prescribed exercise?

- ☐ I do not know how to assess patient reasons or barriers to exercise (1)
  - ☐ Assessing barriers will not or does not change my practice (2)
  - ☐ Not sure what to do with patient barriers once I assess (3)
  - ☐ Takes too much time (4)
  - ☐ Other (5)
-

*Display This Question:*

*If Why do you not assess patient reasoning or barriers to prescribed exercise? = Other*

In the previous question, you answered that you do not assess patient reasons or barriers to exercise for "other" reasons. What other reasons do you have for not assessing patient reasons or barriers?

---

*Display This Question:*

*If Do you assess the reasons or barriers patients have for not completing their prescribed exercise? = No*

What would allow or cause you to begin to assess these patient reasons or barriers to completing prescribed exercise?

---

End of Block: Default Question Block

Start of Block: Block 2

The next section focuses specifically on ***self-efficacy for home exercise programs***. Self-efficacy is one's belief in their ability to successfully complete a task, in this case, home exercise programs.

Do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?

☐ Yes (1)

☐ No (2)

*Display This Question:*

*If Do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?*  
= Yes

In what ways do you assess self-efficacy for home exercise programs? (Check all that apply)

- ☐ Verbal discussion (1)
- ☐ Patient self-report questionnaires (2)
- ☐ Observation (3)
- ☐ Other (4)

---

*Display This Question:*

*If In what ways do you assess self-efficacy for home exercise programs? (Check all that apply) = Other*

In the previous question, you chose "other" as a way you assess self-efficacy for home exercise programs. Please explain the other methods you use to assess self-efficacy.

---

---

*Display This Question:*

*If Do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?*  
= Yes

Based on a patient's self-efficacy, how do you individualize treatment?

---

End of Block: Block 2

---

Start of Block: Block 3

Display This Question:

If Do you assess patient self-efficacy for home exercise prior to prescribing a home exercise program?  
= No

What are your reasons for not assessing a patient's self-efficacy for home exercise programs?  
(Check all that apply)

- ☐ I do not know how to assess patient self-efficacy for home exercise programs (1)
- ☐ Assessing self-efficacy will not change my course of treatment (2)
- ☐ Not sure what to do with patient self-efficacy once I assess (3)
- ☐ I do not know what self-efficacy is or how it pertains to rehabilitation (4)
- ☐ Takes too much time (5)
- ☐ Other (6)

Display This Question:

If What are your reasons for not assessing a patient's self-efficacy for home exercise programs? (Ch...  
= Other

In the previous question, you answered "other." Please explain what other reasons you have for not assessing patients' self-efficacy for home exercise programs.

---

End of Block: Block 3

Start of Block: Block 1

Sex

- ☐ Male (1)
- ☐ Female (2)

What is your date of birth? (m-d-y)

---

---

What type of healthcare provider are you?

☐ Athletic trainer (1)

☐ Physical therapist (2)

☐ Occupational therapist (3)



What setting do you work in?

- ☐ Middle school (1)
- ☐ High school (2)
- ☐ D1 college (3)
- ☐ D2 college (4)
- ☐ D3 college (5)
- ☐ Professional (6)
- ☐ Hospital (7)
- ☐ Education/Research (8)
- ☐ Industrial (9)
- ☐ Acute care (10)
- ☐ Rehab/subacute care (11)
- ☐ Extended care facility/nursing home (12)
- ☐ Outpatient clinic/private practice (13)
- ☐ Home health (14)
- ☐ Hospice (15)
- ☐ Local/state/federal government (16)
- ☐ Mental health (17)

---

How many years of experience do you have as a healthcare professional?

---

---

What is the highest level degree you hold?

☐ Bachelors (1)

☐ Masters (2)

☐ Doctorate (3)

☐ PhD (4)

---

In which state do you currently practice?

▼ Alabama (1) ... Wyoming (50)

## Appendix E. Initial data collection forms

Please indicate the mode of communication you prefer for reporting adherence to your home exercise program:

Phone call \_\_\_\_\_ Text message: \_\_\_\_\_ Email: \_\_\_\_\_

Please circle your level of confidence in completing your prescribed exercises at home.

<i>How confident are you that you could perform the prescribed exercises correctly...</i>		<b>Not Confident</b>		<b>Somewhat Confident</b>			<b>Very Confident</b>	
...as often as prescribed by your clinician?	N A	0	1	2	3	4	5	6
...when you are bored by the program?	N A	0	1	2	3	4	5	6
...when you feel pain when exercising	N A	0	1	2	3	4	5	6
...when you have to exercise alone	N A	0	1	2	3	4	5	6
...when you do not enjoy it	N A	0	1	2	3	4	5	6
...when you are given written exercise instruction	N A	0	1	2	3	4	5	6
...when you are too busy with other activities	N A	0	1	2	3	4	5	6
...if you were given video exercise instruction	N A	0	1	2	3	4	5	6
...when you feel tired	N A	0	1	2	3	4	5	6
...when you feel stressed	N A	0	1	2	3	4	5	6
...when you feel depressed	N A	0	1	2	3	4	5	6
...when you do not have supervision or clinician feedback	N A	0	1	2	3	4	5	6

*Evaluate your confidence in your ability to exercise three times per week for  
20 minutes if:*

<i>How confident are you right now that you could exercise three times per week for 20 minutes if:</i>	<b>Not at all confident</b>		<b>Somewhat confident</b>			<b>Completely confident</b>	
...the weather is bothering you	0	1	2	3	4	5	6
...you were bored by the program or activity	0	1	2	3	4	5	6
...you felt pain when exercising	0	1	2	3	4	5	6
...you had to exercise alone	0	1	2	3	4	5	6
...you did not enjoy it	0	1	2	3	4	5	6
...you were too busy with other activities	0	1	2	3	4	5	6
...you felt tired	0	1	2	3	4	5	6
...you felt stressed	0	1	2	3	4	5	6
...you felt depressed	0	1	2	3	4	5	6

Please rate *how confident you are that you can do the following things at present, despite the pain*. To indicate your answer circle one of the numbers on the scale under each item, where 0 = not at all confident and 6 = completely confident.

Remember, this questionnaire is not asking whether or not you have been doing these things, but rather how confident you are that you can do them at present, despite the pain.

<i>How confident you are that you can do the following things at present, despite the pain:</i>	<b>Not at all confident</b>		<b>Somewhat confident</b>			<b>Completely confident</b>	
I can enjoy things, despite the pain	0	1	2	3	4	5	6
I can do most of the household chores (e.g. tidying-up, washing dishes, etc.), despite the pain	0	1	2	3	4	5	6
I can socialize with my friends or family members as often as I used to do, despite the pain	0	1	2	3	4	5	6
I can cope with my pain in most situations	0	1	2	3	4	5	6
I can do some form of work, despite the pain ("work" includes housework, paid, and unpaid work)	0	1	2	3	4	5	6
I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain	0	1	2	3	4	5	6

I can cope without medication	0	1	2	3	4	5	6
I can still accomplish most of my goals in life, despite pain	0	1	2	3	4	5	6
I can live a normal lifestyle, despite the pain	0	1	2	3	4	5	6
I can gradually become more active, despite pain	0	1	2	3	4	5	6

*Exercise Frequency*

*Prior to your injury, in a typical month, how many times do you exercise strenuously (breaking a sweat, breathing hard) for at least 30 minutes? \_\_\_\_\_ times per month*

*Previous Physical Therapy Experience*

*Prior to your current session, have you previously attended physical therapy for a separate diagnosis?*

- ☐ Yes
- ☐ No

## Appendix F. Home exercise log

### Home Exercise Program Diary

Please indicate with a “X” in the box if you completed your prescribed exercises at home.

<b>WEEK 1</b>	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
<b>Date: (fill in)</b>							
Completed Home Exercises?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>WEEK 2</b>	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
<b>Date: (fill in)</b>							
Completed Home Exercises?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>WEEK 3</b>	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
<b>Date: (fill in)</b>							
Completed Home Exercises?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>WEEK 4</b>	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
<b>Date: (fill in)</b>							
Completed Home Exercises?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

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190. Bishara AJ, Hittner JB. Testing the significance of a correlation with nonnormal data: comparison of Pearson, Spearman, transformation, and resampling approaches. *Psychol Methods.* 2012;17(3):399-417.
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## **Curriculum Vitae**

**Kelsey J. Picha**

### **I. GENERAL INFORMATION**

National Athletic Trainers Board of Certification: #2000010194 Year: 2012-Present

Kentucky Board of Athletic Training License #AT1321 Year: 2015-Present

### **II. EDUCATION**

<b>Years</b>	<b>Institution</b>	<b>Degree</b>	<b>Specialty</b>
2012 – 2014	A.T. Still University	MS	Post-Professional Athletic Training
2008 – 2012	Minnesota State University, Mankato	BAT	Athletic Training

### **III. PROFESSIONAL and CLINICAL EXPERIENCES/APPOINTMENTS**

<b>Years</b>	<b>Institution</b>	<b>Role</b>
2015 – Present	Sports Medicine Research Institute, University of Kentucky, Lexington, KY	Research Assistant
2014 – 2015	Tobler Physical Therapy, Mesa, AZ	Staff Athletic Trainer
2015	Foothills Physical Therapy, Phoenix, AZ	Outreach Athletic Trainer
2014 – 2015	Mountain View High School, Mesa, AZ	Assistant Athletic Trainer
2013 – 2014	Canyon State Academy, Queen Creek, AZ	Head Athletic Trainer
2013 – 2014	Gilbert Pop Warner Football League, Gilbert, AZ	Lead Research Assistant, Datalys Center for Sports Injury Research and Prevention
2013 – 2014	Summit Athletics, Phoenix, AZ	Outreach Athletic Trainer
2012 – 2014	Neuromuscular Research Lab, A.T. Still University, Mesa, AZ	Research Assistant
2012 – 2013	Arizona State University, Tempe, AZ	Graduate Assistant Athletic Trainer, Women's Tennis, Women's Basketball, and Football
2013	Girls Volleyball Camp, Tempe, AZ	Outreach Athletic Trainer
2013	Football Camp, Tempe, AZ	Outreach Athletic Trainer
2013	Youth Baseball Camp, Tempe, AZ	Outreach Athletic Trainer
2013	Fast Action Sports, Mesa, AZ	Outreach Athletic Trainer

#### IV. ACADEMIC APPOINTMENTS

Years	Institution, Program, Department	Role	Level
2014- Present	A.T. University, Kinesiology, College of Graduate Health Studies	Adjunct Professor	Master's Program

#### V. TEACHING ACTIVITY

##### University of Kentucky:

Years	Course #	Course Title	Role	Number of students
Summer 2018	PT 686	Athletic Taping	Instructor	23
Fall 2017	AT 680	Laboratory Techniques in Rehabilitation Science	Teaching Assistant	5
Summer 2017	PT 686	Athletic Taping	Instructor	24
Spring 2017	AT 690	Orthopaedic Evaluation Rehab-Upper Extremity	Teaching Assistant	10
Fall 2016	AT 680	Laboratory Techniques in Rehabilitation Science	Teaching Assistant	5

##### A.T. Still University:

Years	Course #	Course Title	Role	Number of students
2017	SPB1-KINE 5003	Functional Anatomy	Lead Instructor	14
2016	FB1-KINE 5003	Functional Anatomy	Lead Instructor	14
2016	SPB2-KINE 5003	Functional Anatomy	Lead Instructor	10
2016	SPB1-KINE 5003	Functional Anatomy	Lead Instructor	10
2015	FB1-KINE 5003	Functional Anatomy	Lead Instructor	10
2015	KINE 5004	Functional Biomechanics	Teaching Assistant	12

2015	SB2-KINE 5003	Functional Anatomy	Lead Instructor	10
2015	SB1-KINE 5003	Functional Anatomy	Lead Instructor	10
2014	KINE 5003	Functional Anatomy	Teaching Assistant	10
2014 – 2015	KINE 6300	Human Movement Dysfunction	Teaching Assistant	10
2013 – 2014	ANAT	Cadaver Lab	Teaching Assistant	15

## VI. HONORS

Date	Award	Description	Organization
Spring 2013	Gary Delforge Scholarship	Scholarship	NATA Research and Education Scholars
Spring 2011	“Gordy” Graham Scholarship	Scholarship	Minnesota State University, Mankato
Spring 2011	Minnesota Athletic Trainers’ Association Scholarship	Scholarship	Minnesota Athletic Trainers’ Association
Spring 2011	Wendy and Kent Kalm Scholarship	Scholarship	Minnesota State University, Mankato

## VII. RESEARCH AND CREATIVE PRODUCTIVITY

### PUBLICATIONS

#### *Published Journal Articles:* Citation

1. **Picha KJ**, Alamaddah M, Barker J, Ciochetty T, Uhl TL. Elastic Resistance effectiveness on Increasing Strength of Shoulders and Hips. *Strength and Conditioning Research* (Accepted)
2. **Picha KJ**, Uhl TL. Calculation of Resistive Loads for Elastic Resistive Exercises. *Journal of Sports Rehabilitation* (Accepted)
3. Harding JL, **Picha KJ**, Huxel Bliven KC. Relationship between pitch volume, glenohumeral and hip motion and strength in youth baseball pitchers. *Journal of Athletic Training*. 53 (1): 60-65.
4. **Picha KJ**, Howell DM. 2017. A Model to Increase Rehabilitation Adherence to Home Exercise Programs in Patients with Varying Levels of Self-Efficacy. *Musculoskeletal Care* <https://doi.org/10.1002/msc.1194>

5. **Picha, KJ**, Harding JL, Huxel Bliven KC. 2016. Glenohumeral and Hip Range of Motion and Strength Measures in Youth Baseball Athletes. *Journal of Athletic Training*. 51 (6): 466-473.
6. **Picha, KJ**. Patient-Reported Outcome Measures for the Overhead Athlete. *NATA News- Clinical Bottom Line Column*.
7. **Picha KJ**, Weber ML, Welch CE. 2014. Injury Risk and Prevention: An Analysis of Barefoot Versus Shod Distance Running. *International Journal of Athletic Training and Therapy*. #IJATT-0039.
8. Weber ML, **Picha KJ**, Valovich McLeod TC. 2014. Mysterious Heel Pain in Youth: A Guide to Potential Management Strategies. *Journal of Athletic Training and Therapy*. IJATT. 0012.

#### ***Published Book Chapters:***

##### **Citation**

1. *Expert Advice in Sports Medicine: Quick Questions on the Athletic Shoulder*. 2014. Contracted by SLACK, Inc. as Co-author of one chapter in this book, which is part of a four book series. in print.

#### ***Manuscripts in Preparation:***

##### **Citation**

1. Best S, Abt J, Heebner N, Royer S, Winters J, Poploski KM, **Picha K**, Johnson A, Morris S, Lephart S. Human performance training program utilization and training outcomes in United States Marines Special Operations Operators. *Journal of Strength and Conditioning Research* (in review).
2. Poploski, KM, **Picha KJ**, Winters, JD, Royer, S, Heebner, NR, Abt, JP. Patterns and Associations of Shoulder Motion, Strength, and Function in Active Full-Duty MARSOC Personnel. Target journal *American Journal of Sports Medicine* (in review).
3. **Picha KJ**, Uhl TL. Improving Self-Efficacy in Patients with Low Back Pain: a Systematic Review. In preparation, target journal: undecided.
4. Heebner N, **Picha KJ**, Abt J. MARSOC Combat vs Support Epidemiology. Target journal: *Military Medicine* (in review).
5. **Picha, KJ**, Quintana, C, Heebner NH, Glueck AC, Abt, JP, Lephart, SM. 2017. Reliability of Five Novel Reaction Time and Cognitive Load Protocols. In preparation, target journal: *Journal of Sports Rehabilitation*. (in review)
6. **Picha KJ**. An Athletic Trainers Guide to Improving Patient Adherence through Social Cognitive Theory. In preparation, target journal: *Journal of Athletic Training*.
7. Huxel Bliven KC, Swanik KA, **Picha KJ**, Thomas SJ, Fath P. The effects of scapular fatigue on glenohumeral and elbow kinematics during overhead throwing in collegiate baseball players. Target journal: *Athletic Training & Sports Healthcare*.
8. **Picha KJ**, Poploski, KM, Winters, JD, Royer, S, Heebner, NR, Abt, JP. Lifestyle risk factors in MARSOC personnel: Is there a relationship between injury and performance measures? Target journal: *Military Medicine*.
9. Poploski, KM, Winters, JD, **Picha KJ**, Royer, SD, Heebner, NR, Lambert, B, Getsy, W, Abt, JP. 2017. Influence of Limb Dominance and Shoulder Injury on Strength and Explosive Force in US Marines. Target journal: undecided.

#### ***Refereed Abstracts:***

## Citation

1. **Picha KJ**, Hoch MC, Heebner NR, Abt JP, Usher EL, Capilouto GJ, Uhl TL. 2018. Development and Psychometric Properties of the Self-Efficacy for Home Exercise Programs Scale. NATA Annual Conference. *Journal of Athletic Training*. New Orleans, Louisiana.
2. **Picha, KJ**, Quintana, C, Heebner NH, Glueck AC, Abt, JP, Lephart, SM. 2018. Reliability of Five Novel Reaction Time and Cognitive Load Protocols. ACSM Conference. May 29 - Jun 02, 2018; Minneapolis, MN.
3. Lester M, **Picha K**, Jurjans, J; McGuire, R; Uhl, T. Influence of Adherence to In-Clinic and Home-Based Physical Therapy Rehabilitation on Patient-Reported Outcome Measures. CCTS Conference. April 13<sup>th</sup>, 2018. Lexington, KY.
4. Andrews M, Quintana C, Glueck A, **Picha K**, Heebner N, Abt J. The Test-Retest Reliability of the Unilateral Stance Test using the Bertec Balance Advantage-Computerized Dynamic Posturography in a Healthy Population. CCTS Conference. April 13<sup>th</sup>, 2018. Lexington, KY.
5. **Picha K**, Poploski K, Winters J, Heebner N, Abt J. Lephart S. The Relationship between Flexibility and Strength in Active Full-Duty Marines. Big Sky Athletic Training Sports Medicine Conference. February 4-8, 2018; Big Sky, MT.
6. Quintana C, **Picha K**, Poploski K, Heebner N, Abt J. Lephart S. Lifestyle Risk Factors in US Marines: Is There a Relationship to Injury? Big Sky Athletic Training Sports Medicine Conference. February 4-8, 2018; Big Sky, MT.
7. Best S, Abt J, Heebner N, Royer S, Winters J, Poploski K, **Picha K**, Johnson A, Morris S, Lephart S. 2017. Human performance training program utilization and training outcomes in United States Marines special operations operators. *Journal of Science and Medicine in Sport*. 20: S42-S42.
8. **Picha, KJ**, Quintana, C, Heebner NH, Glueck AC, Abt, JP, Lephart, SM. 2017. Reliability of Five Novel Reaction Time and Cognitive Load Protocols. University of Kentucky, KNI Conference.
9. Poploski, KM, Winters, JD, **Picha KJ**, Royer, SD, Heebner, NR, Lambert, B, Getsy, W, Abt, JP. 2017. Influence of Limb Dominance and Shoulder Injury on Strength and Explosive Force in US Marines. APTA CSM.
10. **Picha, KJ**, Almaddah, M, Uhl, TL. 2017. Strength Training Progression Effectiveness Using a Load Cell. *Journal of Athletic Training*. in press
11. Uhl, TL, **Picha, KJ**. 2017. Calculation of Resistive Loads for Elastic Resistive Hip Exercises. *Journal of Athletic Training*. in press
12. **Picha KJ**, Uhl, TL. 2016. Between Day Reliability of Upper and Lower Extremity Isometric Strength Testing Using the BTE Dynamometer. *Journal of Athletic Training*. in press.
13. **Picha K**, Harding JL, Huxel Bliven KC. 2015. Glenohumeral and Hip Range of Motion and Strength Measures in Youth Baseball Athletes. *Journal of Athletic Training*. in press.
14. Harding JL, **Picha K**, Huxel Bliven KC. 2015. Relationship between throwing intensity and pitch volume on shoulder motion and strength in adolescent baseball pitchers. *Journal of Athletic Training*. in press.
15. **Picha K**, Huxel Bliven KC, Bay RC, Snyder Valier AR, Sauers EL. 2014. Normative Values for Health-Related Quality of Life in Healthy and Injured Baseball and Softball

Players Using a Region Specific Patient Self-Report Scale: The Functional Arm Scale for Throwers<sup>®</sup> (FAST<sup>®</sup>). *Journal of Athletic Training*. in press.

16. **Picha K**, Scofield A, Sexton P. Does cold water immersion improve recovery of strength, power, and endurance following exhaustive exercise? National Conference on Undergraduate Research. March 29-31, 2012: Weber State University.